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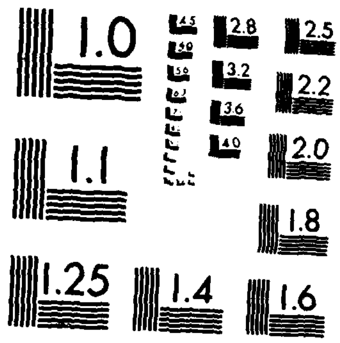

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National Economic Development Procedures Manual - Recreation

Volume I

Recreation Use and Benefit Estimation Techniques

March 1986

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The primary purpose of this report is to provide an expanded description of the recreation evaluation procedures recommeded in the Water Resources Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." The report summarizes the conceptual basis of procedures for recreation valuation associated with water and related land resource planning, describes the mechanics of acceptable valuation methods, and offers criteria for determining the applicability of various methods to particular palnning situations.

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Volume I

Recreation Use and Benefit Estimation Techniques

by

Mary K. Vincent
David A. Moser. Ph.D.
William J. Hansen

U.S. Army Corps of Engineers
Water Resources Support Center
Institute for Water Resources
Fort Belvoir, Virginia 22060-5586

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CHAPTER I: INTRODUCTION

Preauthorization planning for water resources development projects involves an assessment of the anticipated impacts of project alternatives and an information account display of beneficial and adverse effects on National Economic Development, Regional Development, Environmental Quality, and Other Social Effects. National Economic Development (NED) is significant not only as an account but also as a planning objective. Under Principles and Guidelines (P&G), one of the alternative plans to address the needs and opportunities in water and land related planning must be the NED plan. The NED plan reasonably maximizes the net difference between NED benefits and NED costs. NED benefits arise when a Federal investment in water resources increases the nation's output of goods and services or reduces the cost of producing these goods and services. These benefits are measured as the dollar value of the increased output or the dollar value of the reduction in costs. The adverse economic effects are the NED costs which arise because resources are diverted for the project that would have value in alternative uses. These cost are measured as the dollar value of the resources in their next best alternative use.

The purpose of this manual is to provide an expanded description of the recreation evaluation procedures recommended in P&G and to thereby supplement the Planning Guidance Notebook. The manual summarizes the conceptual basis of procedures for recreation valuation associated with water and related land resource planning, describes the mechanics of acceptable valuation methods, and offers criteria for determining the applicability of various methods to particular planning situations. The manual is intended for use in Level C planning and evaluation.

The major requirements of NED benefit evaluation for recreational components of alternative plans may be summarized as follows. For each alternative plan, the planning study must estimate NED benefits by:

a. Estimating the value of projected recreational use that would occur with the plan and also that would be diminished by the plan;

b. Taking into explicit account the competition from other recreational opportunities within the area of influence of the proposed plan;

c. Estimating future recreational use and value, on the basis of socio-economic variables, over the entire life of the project under both with and without project conditions;

d. Calculating benefits as the difference between the with-plan and without-plan value of recreational opportunities within the market area of the project.

Scope and Organization of the Manual

The manual presentation assumes that a planning study's need for an NED recreation benefits evaluation has been established. It also assumes some understanding of the major causes or explanations of patterns in recreational behavior and some ability to forecast the effects of economic and social changes as they may impact on planning alternatives.

This manual does not present the historical development of the various concepts regarding recreation demand and economics, nor is it concerned with any issues surrounding the theories, application, or improvement of existing techniques. This manual conforms to the view that existing techniques are sufficiently well developed to be used in recreation benefit analysis.

There are three major parts to the manual. Chapter II, Basic Concepts, presents the basic material necessary for understanding the rationale of recreation benefits evaluation and the process for conducting such an evaluation within the planning framework. Chapter III discusses different recreation use estimation and valuation techniques as well as considerations for selecting the appropriate technique. Finally, the manual is completed with several appendices that supplement the information in the main text. Included are a series of appendices that provide general guidance for implementing all of the use estimation and valuation techniques described in Chapter III, except for the Contingent Value Method. Detailed guidance for this technique is provided separately in the Contingent Value Methodology Guide, (Moser and Dunning, 1985).

CHAPTER II: BASIC CONCEPTS

This chapter outlines the basics of economic valuation concepts and describes the application of economic theory to the evaluation of outdoor recreation. In addition, this chapter provides a description of how a recreation benefit analysis is developed within a planning framework.

Overview of Recreation Benefit Analysis Within NED

Concept of net benefits. A Federal water resources project may both create and displace recreational opportunities. For example, reservoir-related recreation may be provided while stream and associated terrestrial recreation may be lost. The value of the lost recreational opportunities could be considered as part of the opportunity costs of the project and could be included in NED costs. The approach suggested in P&G is to determine the net recreational gains with the project and to add the value of these gains to NED benefits.

Net NED recreation benefits are defined as the difference between the value of the recreational opportunities gained and the value of the recreational opportunities displaced, and may therefore be positive or negative:

Net Recreation Benefits (+ or -)	=	Value of Benefits Gained	-	Value of Benefits Lost

Willingness to pay as a measure of benefits. NED benefits arising from recreation opportunities created or displaced by a project are measured in terms of aggregate willingness to pay. Total willingness of users to pay is the sum of two components: the actual entrance fees and user charges for the right to use the site plus any excess amount which they would be willing to pay but do not have to pay. This excess amount is the consumers' surplus. Thus for the recreational opportunity created by the project:

Value of Benefits Gained	=	Total Willingness to Pay	=	Entrance Fees and User Charges	+	Consumer Surplus

A similar relationship can be used to represent the value of the benefits lost with the project from the displaced recreational opportunities. Note that the gross benefit is the willingness to pay to gain admittance to the recreational site. It does not include payments made for other goods and services (e.g., food, lodging, transportation or equipment) associated with the recreational activity. These payments are costs that must be incurred for these goods and services to be used as inputs to the recreational experience, not an additional amount users would be able to pay for admittance to the recreational site.

Economic Principles of Valuing Recreation

The basic principle of evaluating NED benefits is to use the concepts developed from the economics of private goods as an analogy for valuing the outputs of Federal water resources projects. Basic principles of economics predict that private markets accurately determine the value of goods to society. The economic model of markets is based on the behavior of producers and consumers in the voluntary exchange of private goods and services. Consumers influence the market through the purchase and consumption of goods and services that provide them with utility or satisfaction. It is assumed that consumers make purchases in markets based on their individual valuations of the goods and services. The external representation of this value is called demand which describes the relationship between the quantity of a good or service that individuals wish to buy and the factors that influence their decisions. Some of the determinants of demand for a particular good include the price of the good as well as income, tastes and preferences, the prices of other goods, and the size of the population of potential purchasers.

The demand for marketed goods is usually represented by a demand curve. A demand curve shows the relationship between the amount of a good people are willing and able to purchase and the price of the good. The typical demand curve obeys the Law of Demand that reductions in the price will result in increases in quantity demanded. The Law of Demand, however, only holds if all the other determinants of demand, such as income and the prices of other goods, remain constant. Changes in these determinants shift the demand curve. For instance, increases in real income or population is predicted to shift the demand curve, for most goods, to the right. The introduction of substitutes or a reduction in the price of substitutes is predicted to shift the demand curve to the left.

The demand curve can also be used to describe the total value of the good to consumers. From economic theory, the area under a market demand curve is considered to measure the total value of the good to consumers. If consumers must pay to obtain the good, the difference between the value to consumers of the quantity they consume and the money they must pay to obtain the good is called consumers' surplus. In Figure II-1 below, if the price of the good is $5 per unit, consumers are willing to purchase 50 units of the good. The total value to the consumers of these 50 units is the area under the demand curve between a quantity of 0 and 50 units. The amount they must pay is $5 per unit X 50 units = $250. The difference, the consumers' surplus, is $5 per unit X 50 units/2 = $125. This amount measures the maximum amount consumers of the good are willing to pay rather than go without the good.

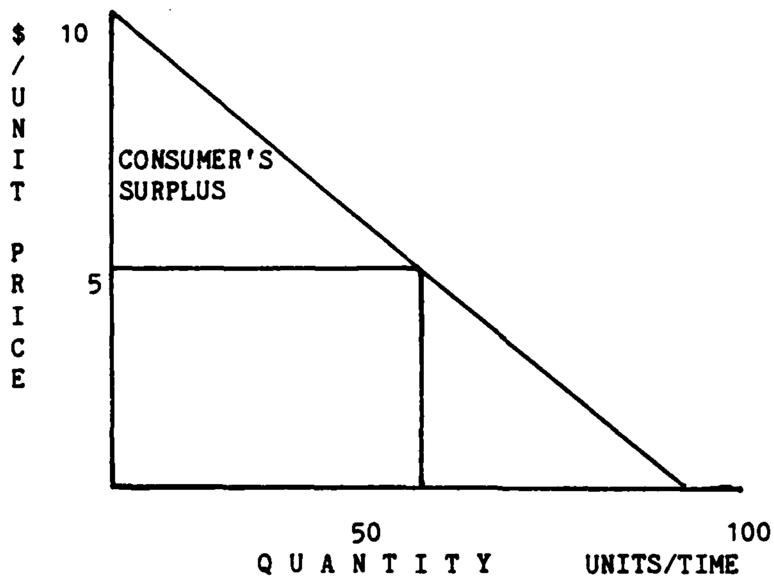

Figure II-1: Demand Curve and Consumers' Surplus Example

Conceptually, a recreational facility has a demand curve analagous to that of a marketed good. Therefore, the area under the demand curve for a boat launching ramp or a beach measures the value of the gross NED benefits, to the users, of providing these facilities. If markets existed for beaches and for boat ramps, we could estimate the market demand for the facilities as a function of the price, the socio-economic characteristics of the user population and other determinants of demand. Then, based on projections of the future values of these determinants, such as real income, population, and distribution, we could predict the present and future demand and value of the recreational site. The analyst attempting to forecast the value of a recreational facility by forecasting demand is faced with several difficult problems. First, many recreational facilities are provided to users without charging a price or admission fee. Therefore, we may only know one point on the demand curve for the site: the quantity demanded at zero price. We would not have any other information about other price-quantity demanded points on the demand curve to determine the value of the site for recreation. Second, analysts are often faced with the problem of forecasting the demand and value of a recreational site that does not exist but is being planned. In this case, we have no direct information at all about the demand for and value of the recreational opportunity.

Several techniques have been developed to estimate recreational demand and value and have been applied to a variety of recreational goods. Three of these techniques are described in P&G: unit day method, travel cost method, and contingent value method. The acceptability of these methods under P&G guidance is shown in Figure II-2. An examination of Figure II-2 indicates that the unit day method is acceptable under very limited situations. Assuming a regional model is not available, the unit day method is acceptable if expected annual visitation is less than 750,000 visitor days and if either, (a) recreation costs do not exceed 25 percent of expected total project costs, or (b) specific annual Federal recreation costs do not exceed $1,000,000 per year.

The P&G does allow for the use of other methods that meet the following criteria of acceptability and that conform to the selection process described in Figure II-2:

1. Valuation is based on an empirical estimate of demand applied to the particular project.

2. Estimates of demand reflect user population distribution and socioeconomic characteristics, characteristics of recreation resources made available, and characteristics of alternative existing recreation opportunities.

3. Valuation accounts for value of losses or gains to existing sites in area of influence (without-project condition).

4. Willingness to pay over time is based on projected changes in underlying determinants of demand.

The three techniques described in P&G can be basically divided into two types: those that approach the measurement of value by considering price and use separately; and those that are demand based considering price and quantity simultaneously.

The unit day method does not attempt to account for the impact of price on visitation to a recreational site. Instead, an assigned user day value is applied to the total number of estimated visitors. The visitation estimate should include the effects of variables that shift the quantity demanded such as population, distance and income. Regardless of the sophistication of the visitation estimation approach, however, the unit day method can only at best provide a rough approximation of the total value of the recreational opportunity to the potential users.

Both the travel cost and contingent value methods determine the value of a recreational site by attempting to approximate the price-quantity demanded relationship. This means they can simultaneously estimate use as well as the willingness to pay for that use. A separate use estimation technique (and study) such as needed by the unit day method is not required.

The travel cost method uses indirect means to determine the price component. Visitation to a site generally varies inversely with travel distance and time to the site, directly with the population of potential users, and may also be dependent on other variables. Thus, participation rates by different user populations at different distances from a site can be

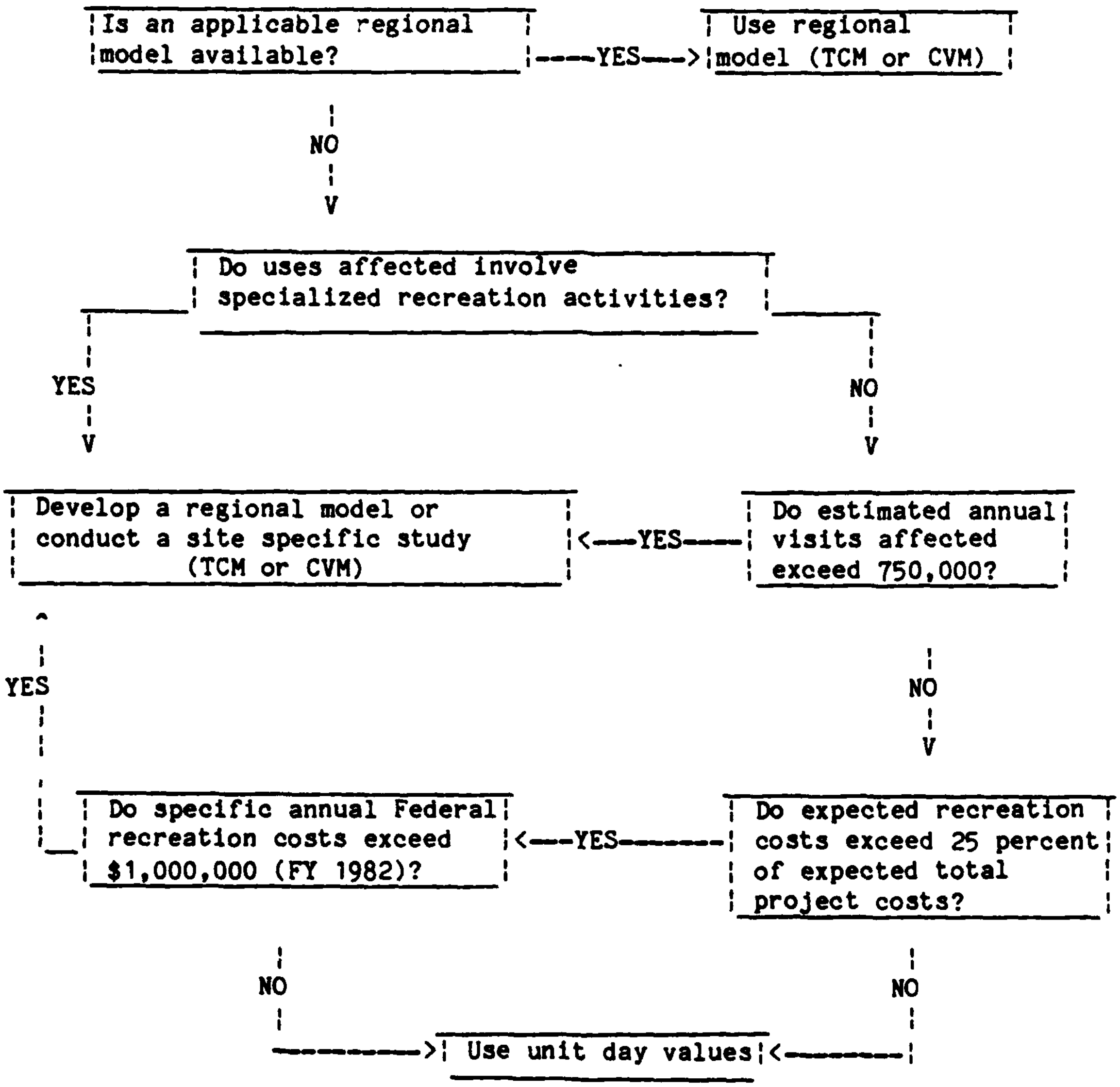

Figure II-2: Criteria for Selecting Procedures for Evaluating Recreation Benefits

Source: P&G Figure 2.8.2

estimated from intercept surveys at similar sites within the region. In the travel cost method, it is assumed that distance or travel time acts as a barrier to the use of the site and that the cost of travel is a measure of that barrier for different user groups. Individuals will only visit a site if the value of the recreational activity at a site is equal or exceeds the cost of traveling to the site. These travel costs are used to impute the maximum admission fee that individuals are willing to pay for the use of the site. The application of the method results in predicting that those individuals living closest to a recreational site are willing to pay the largest entrance fee since they have the lowest travel costs.

The contingent value method is a direct approach to determining the demand and value of a recreational site. Instead of imputing willingness to pay as a travel cost differential, contingent value directly asks potential users of a site the most they would pay to enjoy the recreational site as well as their visitation to the site. The payment is contingent on the provision of the recreational opportunity and the existence of the hypothetical market for the site. This information is then used to simulate a willingness to pay-quantity demanded relationship for the potential user population. Although contingent value can use some of the same techniques as the travel cost method, particularly in predicting visitation, it has several other advantages. For the travel cost method to be usable, there must be sufficient variation between the travel costs of the closest and the farthest potential users. In addition, multiple destination trips present significant difficulties. These problems are typically not associated with the contingent value method. In addition, contingent value can be used to determine the value of a recreational site to current non-users. Economic theory suggests that individuals may be willing to pay some amount to have a recreational opportunity provided so it will be available for their future enjoyment, even if they don't intend to use it immediately. Other individuals may be willing to pay to have a recreational opportunity provided even if they will never visit it. Contingent value can be used to estimate these option and existence values.

In general, the demand based methods are more acceptable from both economic theory and P&G policy perspectives. This should not suggest that each of these methods is without problems. As noted above, the travel cost method is not applicable to every problem. The contingent value method also has several potentially serious problems. Because it is a stated preference approach, there is the potential for the stated willingness to pay responses to be biased. There is also concern whether individuals even know their true willingness to pay. These problems suggest that a degree of caution and skepticism on the part of the analyst is appropriate in using either of these recommended methods. A final test of the results from any method must always be the analyst's informed judgement about the reasonableness of the results.

CHAPTER III: BASIC CONSIDERATIONS TO UNDERSTANDING A BENEFITS EVALUATION

Components of the Procedure for Benefit Estimation and Tools Available for Each Component

The benefit estimation process consists of two basic components:
- o estimating recreation use
- o estimating the value of the recreation use

There are several techniques available for both use estimation and use valuation:

Techniques for estimating recreation use
o Use Estimating Models - regional models - site specific models
o The Similar Project Method
o The Capacity Method

Techniques for estimating the value of recreation use:
o Travel Cost Method
o Contingent Value Method
o Unit Day Value

Although the P&G makes a distinction between use estimation and valuation, it should be noted that the travel cost must, and the contingent value can, include both components. That is, in the case of the travel cost method, the use estimation model or similar project data (described below) used to estimate recreation use is also used directly in the valuation process. The valuation process is an analytical one, not requiring a second technique per se. This is an obvious advantage of the travel cost approach. Similarly the contingent value method can also be used to simultaneoulsy elicit information on use and value not requiring a separate use estimation technique or study effort. The unit day method, on the other hand, provides only an estimate of value and must be used in conjunction with some other use estimation technique.

In selecting both a use and a valuation technique, consideration must be given to certain characteristics of the proposed project as well as to data and other resources available to the planning study. This chapter provides a basic description of each of the use estimation and valuation techniques as well as guidelines for selecting techniques appropriate for use on a given project.

Description of Techniques for Estimating Recreation Use

There are three techniques that are considered by the Council's procedures to be acceptable for predicting the recreational use associated with plan alternatives:

- o use estimating models, of which there are two types: regional and site specific
- o the similar project method
- o the capacity method

Use Estimating Models

The use estimating models are the most technically sound and hence acceptable methods for use prediction. This technique has the capability for explicitly accounting for variation in recreation demand. It yields use estimates that are a product of multivariate analysis of such use-explaining variables as demographic and socioeconomic characteristics of market areas, availability of substitute recreation opportunities, travel distance, and quality factors. The equation for estimating use may be developed from data from a single (site specific) or group (regional model) of projects.

Within the general category of use estimation models is a sub-category that are often called gravity models. These are use estimation models that include the distance between user populations and recreation supply area(s) as a major explanatory variable. These models are also referred to as travel cost models and, when certain underlying assumptions are met, can be used for both use estimation and valuation.

Regional Models. The Water Resources Council's Principles and Guidelines (P&G) (2.8.9(1)) define Regional Use Estimating Models as statistical models that relate use to the relevant determinants based on data from existing recreation sites in the study area. One of the primary advantages of regional models is that by using cross sectional data from a number of different sites, the effect on actual behavior of different project features (e.g. lake pool size or water quality), can be explicitly tested.

The Principles and Guidelines recognize that the application of Regional Use Estimating Models can significantly reduce the time and effort required to conduct an evaluation of benefits for a proposed project. The WRC Principles and Guidelines not only encourage the use of regional models but also state that if an applicable use estimating model has already been developed for the region in which a proposed project is to be located, it should be used.

As indicated in P&G, the WRC intended to develop, publish, and periodically update a list of available regional models that may be used to evaluate proposed projects. However, because of organizational changes, the WRC has not been able to undertake the task. Nevertheless, the WRC has issued guidelines for regional models, which, by providing a set of criteria and characteristics that are desirable in such models, has served to accomplish the preparatory work for undertaking the task. The WRC guidelines appeared in the WRC Reference Handbook for fiscal year 1982; for convenience, they are provided in paragraphs a-d, below.

a. Introduction or Purpose

The purpose of these guidelines for recreation models is to encourage development of meaningful regional use and benefit estimating models consistent with the intent of the Procedures for Evaluation of National Economic Development Benefits and Costs (18 CFR 713, Part K). These guidelines should foster interagency cooperation in model development by providing a common set of criteria and characteristics of desirable regional models.

b. Nature of the Criteria

The criteria are based on the planning and evaluation information that models should provide rather than their detailed structural characteristics. This emphasis on model performance will permit innovation and flexibility in model design, choice of variables, data collection strategies, and development of recreation use estimates. Good estimating models, in general, are based on statistically sound methodologies, incorporate relevant variables, are replicable, and have predictive power. Specifically, regional recreation models should yield an empirical estimate of demand applied to the particular project or site based on: (1) socioeconomic characteristics of market area populations, (2) qualitative characteristics and uniqueness of the recreation opportunities, and (3) costs and characteristics of substitute opportunities. Models should permit generation of recreation use projections over time that vary with underlying determinants of demand, and allow for evaluation of gains and losses in the study area. The model should reflect the effects of site congestion on the users' willingness to pay for the recreation opportunity and then be able to evaluate the possible long term effects of congestion on site characteristics.

c. Concept of the Region

The region must be determined by a combination of factors based on relevant activities (functional), types of recreation resources, geographical boundaries (spatial), geographic distribution of prospective recreation users, etc. A helpful step is to take into account existing or future sites that may be significant substitutes for the proposed site(s). Thus, the concept of the region, as defined in the NED procedures, is not to use pre-established areas, but to define regions iteratively during the study as planners develop parameters for a cross section of sites and determine which are relevant to water related activities of the proposed sites. Planners should choose a sample containing a representative number of sites so that the variables will have predictive power.

d. Application of the Model

The model should be able to be applied to sites rather than to market areas because water resource planning is designed to produce changes at specific locations rather than to abstract area-wide markets of recreation goods and services. The estimates of value to be obtained from the model should be consistent with and of a level of precision similar to the estimates of value derived for other goods and services produced by a plan.

The procedures should be readily applicable to evaluating proposed changes on the availability of the specific recreation opportunities affected by the plans. For example, can the model estimate the benefit of an additional opportunity of a recreation activity at a particular location? Have questions concerning the relevant resources and sites been included in the household or similar surveys?

When meaningful to the resource situation being evaluated, the consideration of substitution should account for choices among (a) recreational and non-recreational activities, (b) alternative recreational activities, and (c) alternative sites for identical activities.

By following these guidelines, the regional recreation models developed by planners and researchers should be realistic in terms of their applicability to the water based recreation setting being evaluated.

The key statement in the guidelines is that the region is to be determined on a functional basis, not a spatial one. Functional definition of a region must take into account interaction or the substitutional effects among specific sites.

Site-specific Models. The primary differences between regional and site-specific models is that data from only one project are used for the latter. This makes it more difficult to account for the impact on actual behavior of changes in site specific qualitative variables. These can only be explicitly accounted for by conducting longitudinal studies encompassing periods during which such qualitative changes occur at the single site. Contingent value studies could, however, be used to determine individuals perceived reaction to qualitative changes for inclusion in such models.

The Corps of Engineers has pioneered in the development of both regional and site specific use estimating procedures for application to both reservoir and non-reservoir planning situations. For example, a regional use estimating model (Brown and Hansen, Vol. V, 1974) based on the statistical analysis of seven reservoirs in the Sacramento District estimates annual day use visitation as a function of the projected population for the year of estimate, the road mile distances between the proposed project and users points of origin, the water surface area, and the availability of recreation alternatives in relation to the proposed reservoir. The use estimation equation developed for this model is a good example because it takes into account those variables that are considered to be critical to recreation use regardless of location. General guidance on the development and application of use estimation models based on this work is provided in Appendix C.

Similar Project Method

The similar project method involves comparing certain characteristics of the proposed project with those of a bank of existing water resources projects for which use statistics and other information have been compiled (site specific studies). The objective is to match the proposed project as closely as possible to one of the projects in the bank. The method assumes that if the proposed project displays characteristics that are similar to an existing project, than recreation use at the proposed project may be expected to be similar to that at the existing project. The characteristics that are compared include: project type, size, and quality; market area demographic characteristics; user characteristics; existence and relative location of competing recreation opportunities; and other demand variables.

Because of the large number of variables which normally are involved, it is rarely possible to obtain exact matches which would allow the direct estimation of use. For this reason, the most efficient and technically sound similar project techniques are those which provide for the development of per capita use curves (i.e., gravity models comparing per capita rates of use against travel distance) from which use estimates are then indirectly derived. In procedural terms such techniques initially involve the identification of a basic per capita use curve which belongs to that project in the data bank which most closely resembles the proposed project, including resemblance of user characteristics. The shape and location of the per capita use curve is then manually adjusted in order to account for the significant differences which may exist between the respective projects and to explicitly account for demand variables which are unique to the planning alternative. Manual adjustment is admittedly subjective, but the degree of accuracy can be improved by generalizing on experience with the technique.

One important disadvantage of the similar project method is that it does not explicitly consider substitutes, site attributes, and socioeconomic characteristics. One advantage of the method is that when it employs per capita use curves based on travel distance, the resulting incremental use estimates can be used directly as input for applying the travel cost method for use valuation. General guidance on the implementation of the similar project approach is provided in Appendix D.

Capacity Method

The capacity method involves the estimation of annual recreation use based on instantaneous resource or facility capacities and expected daily, weekly and seasonal use patterns. Since the estimates are based on instantaneous capacities which normally remain constant, annual use estimates will not vary over time unless changes are anticipated in seasonal use patterns. Likewise seasonal use patterns, which are climate and culture dependent, will probably account for the greatest variation in use estimates between projects.

Because the capacity method does not involve the estimation of site-specific demand, its use is valid only when it has been otherwise determined that sufficient need exists in the market area of the proposed project to accommodate the project's calculated capacity. Determination of the market area need is done as Step 4 (Determine the Without-Project Condition) of the planning framework.

The capacity method has its greatest potential for use in urban settings when it is immediately obvious that sufficient need exists for the opportunities that the proposed project could provide. Use of the method should be limited to small projects possessing a facility orientation (as opposed to a resource attraction) and having restricted market areas. General guidance on the application of the capacity method is provided in Appendix E.

Summary of Considerations on Use Estimation Techniques

The Water Resources Council encourages use of regional models where available. Even if a regional model is available there may be circumstances, however, in which it would be better to develop a site- specific model: for example, in situations in which the proposed project is unique or else will provide or displace an activity or resources to which the regional model is not amenable. Table III-1 summarizes the major points to consider in selecting a use estimation technique. One of the chief points to note is that use of the capacity method for estimating use precludes application of the travel cost method for valuation.

Because of the limitations of the capacity method, the similar project approach and the use estimating models are the most desirable techniques for use estimation. The similar project approach is much simpler to use than the models but it requires substantial judgement by the planner to account for differences in factors (e.g., water surface acreage) between the existing project from which it was developed and the proposed project at which it is to be applied. A use estimation model requires more work by way of the measurement of variables and testing for statistical significance, but it enables and eases the explicit consideration of such factors as site characteristics, available substitutes, and the socio-economic characteristics of potential users.

Techniques for Estimating the Value of Recreation Use

The methods which are recognized in the Council's procedures as being acceptable for valuating recreation use are the travel cost method, the contingent value method, and the unit day method. Other methods may be used if they satisfy the following acceptability criteria, which were established by the Council:

- Evaluation is based on an empirical estimate of demand applied to the particular project.

- Estimates of demand reflect the socioeconomic characteristics of market area populations, qualitative characteristics of the recreation resources under study, and characteristics of alternative existing recreation opportunities.

Table III-1

Considerations in the Utility of Techniques for Estimating Recreation Use

Consideration	Use Estimating Model (UEM)	Similar Project Method	Capacity Method
Advantages:	o Relates use to relevant use-determining variables o Statistically sophisticated	o Based on per capita use curves relating per capita rate of use to travel distance	o Speed of application
Disadvantages:	o Data availability o Time requirements	o Exact matches to similar projects are rarely possible o Subjectivity inherent in adjusting per capita use curve	o Provides no information on trip generation o Does not involve estimation of site specific demand
Appropriate Circumstances for Use:	o Data on use-determing variables are available or obtainable	o UEM not available and cannot be developed because of data limitations o Data bank on existing projects is available	o Market area recreation need clearly exceeds recreation capacity of proposed project o Small projects with restricted market area
Applications for use Valuation:	o Has direct application for use in the travel cost method o Technically is overly sophisticated for use with the unit day value method	o Incremental use estimates have direct application for use in the travel cost method	o *Precludes use of* the travel cost method

- o Evaluation accounts for the value of losses or gains to existing sites in the study area affected by the project (without project condition).
- o Willingness to pay projections over time are based on projected changes in underlying determinants of demand.

If other valuation procedures are used, evidence of their conformance to the criteria must be given.

This section provides information on the three WRC recognized valuation methods so as to help in selecting one suitable for a particular project. For each method this material includes: a brief description, the basic principles and assumptions, and remarks on appropriate use.

Travel Cost Method

Brief Description. The travel cost method uses the variable costs of travel as a proxy for price in determining net willingness to pay for increments or decrements of supply above fees and user charges. The variable costs of travel include travel distance and the value of travel time. Because travel distance and travel time provide the basis for evaluation, the method builds directly off gravity type use estimation models. These models describe in a mathematical form (curve or equation) the relationship between the location of a population mass and the frequency of visits to a given recreation area. The travel cost method is based on empirical data of recreation visitors making use of the opportunity to participate in activities at existing areas and so derives use estimates based on the actual market behavior of individuals. The demand curve it generates for a resource area, however, is indirectly imputed because the method uses expenditure behavior as a proxy for price.

Briefly, the process for applying a use estimation model to derive a demand curve for the resource being evaluated can be described as follows. First, the model is applied to all areas of origin of potential users using actual mileage data and other variable measurements included in the model. The predicted use from all origins is summed to obtain an estimate of total use at zero price. It is then assumed that participants will react to an increase in fees just as they do to an increase in travel cost. Therefore, the travel distance for each origin is incremented by a fixed amount with the associated travel cost used as the proxy for price, and the model used to estimate use at this new hypothetical fee level. The procedure is repeated, and successive estimates of use at each level of fees obtained. These estimates are then used to construct a site demand curve. Consumer's net willingness to pay for the opportunity to participate in recreation at the site or resource is estimated by the area under this demand curve. An estimate of gross willingness to pay may then be obtained by adding site entry or use fees, if any, to net willingness to pay.

Basic Principles and Assumptions. The travel cost model is developed by using actual observations on use and user characteristics from various origins to a site. The wide range of costs facing individuals at different distances from a site provides considerable information about the influence of costs on participation. This information can be used to generate a demand curve (i.e., estimates of participation at various entry fees). A direct measure of site demand would require data relating site use to various levels of user fees. Since actual fees show little variation, and are not charged for many sites, only indirect estimation of the demand curve is possible. An experiment with changing site fees is an obvious way to find the demand curve at an existing site. It might provide a useful check on other methods, however, the practicality of such an undertaking is subject to question.

A number of assumptions are either implicitly or explicitly made in the use of the travel cost approach. Three major assumptions are listed below. These must be satisfied in order for the method to provide useful estimates of use and benefits.

1. Entry Fees: It is assumed that an individual would react to an increase in entry fees in the same manner as to an increase in travel costs. That is, recreationists treat travel expenditures as equivalent to admission costs.*

2. Specification: The assumption is made that all relevant and statistically significant variables which affect trip-making behavior are included in the use estimation procedures. Under this assumption, unbiased estimates of the slope of the site demand curve may be found.

3. Capacity Constraints: It is assumed that observed data points used to estimate the original use estimation model are true demand points. That is, there is no unobserved demand that is unsatisfied due to capacity restrictions at the sites where the data are collected, or if people are turned away, it is done so randomly with respect to the distance they traveled to use the site.

Appropriate Use. In general, the travel cost method is the appropriate use valuation technique to apply when the following circumstances exist:

1. There is sufficient variation in travel costs among users to allow estimation of demand.

2. The proposed changes being evaluated are significant enough to alter travel cost to some individuals or to alter the number of trips that will be made at the existing travel cost.

3. The travel expenses have been made mainly for the purpose of recreation at the resource which is to be evaluated.

The travel cost method has broad application, but it is clearly most suited for rural sites where users may come from a wide range of distances and

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* Recent work by Bowes and Loomis (1980) indicates this assumption may not be as critical as once thought.

when most visits result from trips made for the sole purpose of using the site. It is less useful for urban parks where there may be too little variation in travel costs.

The circumstances under which the travel cost method is not suited should also be mentioned:

1. It is not appropriate for evaluating the benefits of a site which has insufficient capacity to meet demand unless it can be shown that individuals are turned away randomly with respect to distance traveled.

2. It is difficult to apply the method when the purpose of the trip is not primarily for the sole purpose of visiting that site.

3. It cannot be applied to recreation activities involving limited travel. There must be sufficient variation in travel distance to trace out a demand curve.

General guidance on applying the valuation portion of the travel cost method is provided in Appendix F. A detailed example of a travel cost application, including development and use of a site-specific use estimation model is provided in Appendix G.

Contingent Valuation Method

Brief Description. The contingent valuation method estimates changes in NED benefits based on the willingness to pay and the level of participation by individual recreationists. This price quantity consumed relationship is determined by directly asking individual recreationists (either through a mail questionnaire or a telephone or personal interview) questions that indicate their willingness to pay entry fees for recreation opportunities.

Contingent valuation methods consist of designing and using hypothetical markets to identify the value of recreational amenities, just as actual markets would, if they existed. Three basic steps are involved: (1) the analyst establishes a hypothetical market, in detail; (2) the analyst communicates that hypothetical market to the respondent and permits the respondent to "use" the hypothetical market to make "trades" and establish prices or values which reflect the respondent's individual valuation of the goods, services and amenities "bought" or "sold"; and, (3) the analyst treats the values reported by the respondent as individual values for the goods, contingent upon the existence of the hypothetical market, and treats them, along with the data contained in the market description (step 1) as basic data for estimation of the aggregate value of the goods, services, and amenities.

Basic Principles and Assumptions. The contingent value method specifically differs from the travel cost method in that, rather than being based on actual demonstrated behavior of users, it is based on their contingent behavior. The contingent value method is predicated on the assumptions that: (1) consumers can assign an accurate value to recreation experience, (2) that this valuation can be directly elicited from them in response to questionnaires.

Appropriate Use. Successful application of the contingent value method demands a high degree of skill and precision in the development, pretesting, and conduct of survey instruments to minimize the opportunity for biased responses and to maximize the consistency and repeatability of results. Some of the advantages of the method are: (1) it obtains direct estimates of consumer surplus and therefore is not dependent on historical use statistics or other types of historical data; (2) it is particularly useful for evaluating small changes in quality and differences in management strategies; (3) it is capable of quantifying the effects of projects on the value of competing recreation areas; (4) it can be used to evaluate sites that may be one of several destinations visited on a single trip; (5) it can be used to evaluate the effect of congestion; and (6) it can be used for sites or activities with insufficient variation in travel distance for using the travel cost method. For a more complete description of the use of the contingent value method to evaluate recreational components of Corps projects, see the Contingent Value Methodology Guide (Moser and Dunning, 1985).

Unit Day Value Method

Brief Description. The unit day value method applies a simulated market value to projected use. The simulated value is judgmentally derived from a range of values agreed to by Federal water resource agencies (P&G). It is intended to represent the users average willingness to pay for a day of recreation activity at the site. When a properly formulated unit day value is applied to estimated use, an approximation of the area under the site demand curve is obtained, which is used in estimating recreation benefits.

A national schedule is available (in the Planning Guidance Notebook) showing a range of values for each of two types of recreational opportunities: general and specialized. General opportunities are those that appeal to the majority of recreationists and that usually require the development of access or facilities, e.g., picnicking and boating. Specialized opportunities, in general, are limited, and are associated with low intensity of use and high user skills. A survey of market (private) prices or a point rating system can be used to select a specific value from the published schedule of value ranges.

Basic Principles and Assumptions. The method inherently relies on professional judgement to arrive at a project specific unit day value. Consistent application of the procedure for each alternative being evaluated will produce meaningful estimates of value. When using the unit day value method, departure from the published range of values is not permissible.

Appropriate Use. When preliminary evaluations indicate a value outside of the published range of value, either a travel cost or a contingent value study is generally indicated.

General guidance on the implementation of the unit day approach is provided in Appendix H.

Summary of Consideration on Use Valuation Techniques

The Water Resources Council procedures include a decision flowchart of criteria to consider in selecting a valuation technique. The flowchart was given earlier in this manual as Figure II-2. An adapted version of this flowchart is provided as Figure III-1. It may be necessary to employ two different valuation techniques on the same study. This is because an appropriate technique must be selected for each of two categories of use:

a. expected use of facilities to be provided by the project (including transfer of use from other sites).
b. existing site use to be displaced or eliminated by the project.

In addition, different techniques could be needed within each category of use if both generalized and specialized recreation activities are affected.

Use of the unit day value technique is not warranted if an applicable regional model is available. If a regional model is not available, use of the unit day value method is appropriate only when the estimated number of annual visits affected is less than 750,000. Even under this condition, the unit day value method should not be applied if expected recreation costs not only exceed 25 percent of the expected project costs, but also if the annual Federal recreation costs exceed $1,000,000 (FY 1982).

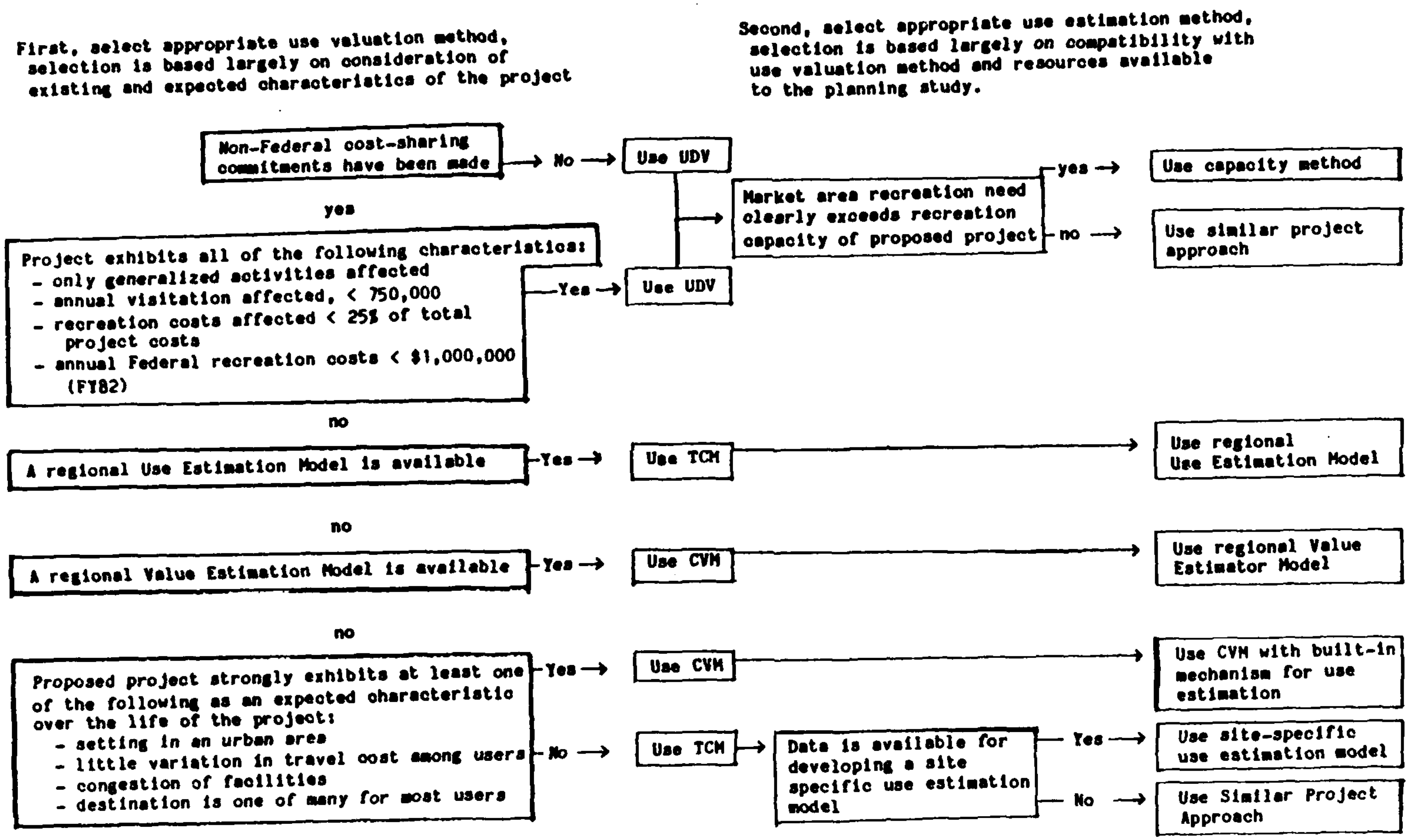

Figure III-3: Flow Chart Summary Guidance to Aid in Selection of Use Estimation and Use Valuation Techniques for Any Given Recreation Benefit

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APPENDIX A: GLOSSARY

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Accessibility: the relative difficulty or ease of access; its distance from the visitor's point of origin; its nearness to other developed or undeveloped sites or areas; and its natural, physical characteristics.

Benefit: gross value, positive or negative, of recreation use of the resource for the with-project condition less the gross loss in recreation caused by the project or plan.

Carrying Capacity: the number of users (for example, per acre) per day that can be accommodated without deterioration of the resource or the recreation activity. These are a function of user-site interactions varying according to personal taste, the nature of the recreational activity, quality of facility design, the natural features of the site and the levels of investment in cultural treatments, supervision, and education.

Consumer Surplus: a concept of the net benefit to consumers, or the willingness of consumers to pay in excess of their actual payment. It is represented as the area under the demand curve above the price line. Consumer Surplus is also known as unpaid for value.

Demand: a schedule of quantities of goods or services that an individual or group of individuals will purchase at various prices. Refers to the quantity or number of units of a good or service demanded at specific levels of price.

General Recreation: refers to a category of recreation activities. General recreation involves primarily those activities attractive to the majority of outdoor recreationists and which generally require the development of convenient access and adequate facilities. This category includes, but is not limited to, swimming, picnicking, hiking, sightseeing, nature studies, tent and trailer camping, water skiing, scuba diving, motor boating, sailing, and canoeing in placid waters. It also includes most warm water fishing, small game hunting, and marine pier and party boat fishing.

Market Area: the area within which some percent (e.g. 80 percent) of the potential day use visitation and some percentage (e.g. 50 percent) of the potential overnight and weekend use visitation would originate plus an additional area containing the alternative recreation opportunities for market area populations. In heavily populated areas, the market area may constitute an hour's drive or approximately 50 miles. Good roads and lack of alternative recreational opportunities may indicate that the market areas should be extended based upon local conditions and habits of users at other recreational development in the area. On the other hand, topographical features or barriers may determine that the market area be retracted.

National Economic Development: A national objective of water resources planning. Contributions to national economic development (NED) are increases in the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.

Net Recreation Benefits: difference between the value of the gains and the value of the losses; net benefits may be positive or negative.

Outdoor Recreational Activities: include water-dependent activities such as swimming, boating, water-skiing, and fishing and water-enhanced activities such as camping, hiking, picnicking, hunting, birdwatching, wildlife photography, sightseeing, and other activities. (FR 44(242): 72985, 14 Dec. 1979; P&S revised)

Potential Use: the expected visitation at prevailing prices unconstrained by supply.

Recreation Area: a tract of land and water area of substantial size which may contain one or several recreational activities on a project. Usually reached by a single access road for control purposes.

Recreation Day: a standard unit of use consisting of a visit by one individual to a recreation development or area for recreation purposes during any reasonable portion or all of a 24-hour period.

Recreational Development: any type of facility or improvements which are planned, designed, developed and managed for recreational purposes.

Recreational Experience: a human experience that finds its source in voluntary engagements that are motivated by inherent self-actualization satisfactions derived therefrom and that occur during non-obligated time.

Recreation Facilities: investments in equipment or modification of resources in order to provide for certain kinds of recreational use.

Recreation Resources: include those lands and waters and the living resources supported by them that are or can reasonably be expected to become available or developed for public use in the absence of the project being considered.

Recreation Supply: a measure of the capability of existing resources or facilities to satisfy recreation demands without consideration of the proposed project or programs.

Specialized Recreation: refers to a category of recreation activities. Specialized recreation involves those outdoor activities for which opportunities, in general, are limited, intensity of use is low, and users' skill, knowledge, and appreciation are great, and which often involve a large personal expense by the user. This category includes, but is not limited to, cold water fishing, upland bird and waterfowl hunting, wilderness pack trips, white water boating and canoeing, and long-range cruises in areas of outstanding scenic environment.

Use: recreational attendance. Actual participation in or consumption of recreational resources. Not to be confused with demand, use is the realization of both demand and supply considerations.

Willingness to Pay: a concept of the willingness of users to pay for each increment of output provided. For recreation output, willingness to pay is the concept of payment by participants specifically for the use of a site or an area. Recreational willingness to pay includes entry and use fees actually paid and also an estimate of the maximum amount in excess of these charges that users could be induced to pay. It is not appropriate to include payment for equipment, food, travel, or lodging that may be made in conjunction with the recreation experience since these payments represent the opportunity costs of the items purchased. Net willingness to pay is represented as the area under the demand curve between the old and new supply and is conceptually the increase in consumers' surplus.

APPENDIX B: SOURCES FOR DATA AND INFORMATION

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Sources of Data

Sources of data and other support for use estimation and evaluation purposes are many and varied. The following table outlines the sources of some significant data and other support material for the various methods according to a functional breakdown.

Function	Data Services
1. Needs determination	
a. Local per capita participation rates	State Comprehensive Outdoor Recreation Plans (SCORPS) Market area survey
b. Regional and national participation rates and outdoor recreational trends	SCORPS National Park Service (NPS) - National Recreation Survey data* US Fish and Wildlife Service (FWS) - National Survey of Fishing and and Hunting data National Marine Fisheries Service (NMFS) - NMFS National Salt Water Angling Survey data
c. Market area population projections	OBERS or supportable alternative Level A and B planning reports
d. Recreation supply, demand and needs	SCORPS Level A and B planning reports Local outdoor recreation plans
2. Determination of least cost alternatives	
a. Unused capacity	Physical inventory of existing recreation areas and facilities in influence area Local outdoor recreation plans SCORPS Project development and operation plans Project master plans

* Former Heritage Conservation and Recreation Service responsibility for National Recreation Surveys has been assigned to NPS.

b. Cost data	SCORPS Local outdoor recreation plans Federal agency cost criteria
3. Use estimation	
a. Without-project use estimation	SCORPS Population trends (OBERS or alternative) Outdoor recreation trends - NPS, FWS, NMFS Survey and appraisal of resources and sites in influence area
b. Availability of regional estimators	Literature search Requests for proposals and requests for quotations
c. Similar project method	
(1) Visitation data	Historical use statistics
(2) Origin of visitors	Visitor surveys Registration (e.g. campground receipt) forms
(3) Project characteristics	Physical inventory and description through on-site survey
(4) Market area characteristics	Market area analysis Census data, OBERS
(5) Availability of substitutes	Inventory and appraisal of existing recreation areas and facilities in influence areas SCORPS
(6) Distance from point of origin of visitors to recreation areas	Map measure
d. Capacity method	
(1) Needs determination	See main heading above
(2) Resource requirements (e.g., land/water ratios)	Agency planning and design criteria Visitor surveys
(3) Site development standards	Agency planning and design criteria Visitor surveys

(4) Facility standards	Agency planning and design criteria Visitor surveys

4. Evaluation

a. Travel cost method

(1) Stage 1 site demand curve	Per capita use curves (see regional estimator and similar project method above)
(2) Value of time	Minimum wage or supportable alternative
(3) Variable costs of travel	Department of Transportation data
(4) Entrance fees and user charges	Market area survey and agency operating policies and fee schedules

b. Contingent valuation method and VEM development	Literature search Requests for proposals and requests for quotations

c. Unit day comparable market price method

(1) Existing price schedules	Survey of influence area
(2) Project impact on existing supply	Survey of existing supply in influence area

d. Unit day general national estimate method

(1) Categorization of recreation activity	Historical use statistics Project development and master plans
(2) Recreation experience	Project development and master plans
(3) Availability of opportunity	Physical survey of influence area, SCORPS and local recreation plans Level A and B planning reports
(4) Carrying capacity	Agency recreation plans
(5) Accessibility	Agency recreation plans
(6) Environmental quality	Agency recreation plans and resource inventory

Data Bases

There are a number of data bases that contain project-specific information on actual recreation use and/or facilities. Among the more prominent of these are:

1. Recreation Information System (RIM).
   U.S. Forest Service, Washington, DC

   Content: Information, over time, on the facilities, description, and use of all recreation areas in the Forest Service.
   Output: The principal reports are annual reports on recreation use by location and type, directory of recreation facilities, and annual plans for construction and maintenance.

2. Recreation Survey Processing System.
   Tennessee Valley Authority

   Content: Information on activities and facilities use at selected TVA Public Use Areas for use in recreation planning and budgeting. Data collected includes number of visits, hours of use by activity, and type of facilities used. There are about 3,000 observations per year.
   Output: Recreation visitation at selected TVA public use areas.

3. Annual Recreation Development and Use Survey.
   Tennessee Valley Authority

   Content: Information on the specific type and value of facilities provided at individual recreation sites throughout the TVA reservoir system.
   Output: Survey of total recreation facilities and visits to reservoirs, value of recreation facilities, and estimates of man-hours of recreation employment.

4. Recreation Resource Management System.
   U.S. Army Corps of Engineers, Office, Chief of Engineers

   Content: Corps-wide recreation data on projects having an annual visitation of at least 5000 recreation days of use. The system contains variables such as monthly visitation, percent use by activity, number of concessions, and length of trails for over 450 projects.
   Output: Project data by year, trends are not reported or analyzed.

Sources of Information

The literature provides an extensive body of existing written information on recreation economics. Examples of journals that are excellent sources for literature on this subject: (1) Journal of Land Economics; (2) Journal of Environmental Economics and Management; (3) American Journal of Agricultural Economics; (4) Journal of Leisure Research; and (5) Leisure Sciences. These journals should be consulted in order to keep up with concepts, developments, and technique applications.

Knowledgeable persons are another excellent source of information and an invaluable aid in supplementing and elucidating the literature. Many of these people are in universities, but resource agencies are also good locations.

Finally, a source of information that would be useful for anyone preparing to undertake a survey, is a book by Don Dillman. The full citation for this reference is:

Dillman, Don A. 1978. Mail and telephone surveys: the total design method. Wiley Interscience. New York.

This book is a catalog of response surveys and an aid in what to include as well as avoid in developing and conducting a survey.

There are also two other books that should be mentioned as being useful to questionnaire preparation:

Stouffer, S.A. et. al. 1950. Measurement and prediction. Princeton University Press. Princeton, N.J.

Shaw, M.E. and J.M. Wright, 1967. Scales for measurement of attitudes. McGraw-Hill, N.Y.

APPENDIX C: USE ESTIMATION MODELING

APPENDIX C: USE ESTIMATION MODELING

Formulating a Regional Model

Basically, the development of a regional model involves the determination of what factors influence recreation use and how they are related. Data are needed on each of the factors to be considered and on the observations of use associated with some range of variations in each factor. This is necessary in order to determine if differences in the magnitude or quantity of the variables have any effect on use rates and what this impact might be. For example, the effect of distance on use can be seen only by observing the visitation from population centers of varying distances form the recreation resource. If all users were an equal distance from the resource it would be impossible to estimate what visitation might be expected at any other distance.

Estimates of use at a proposed new recreation area can be derived from empirical estimates of the relationship between observed use at existing areas and the influencing factors. This relationship, which is to be empirically calibrated, can be put in terms of an expression or model such as the following:

$$V_{ij} = f(D_{ij}, P_i, E_i, A_j, S_{ij})$$

Here the independent variable V_{ij} may be visitation from a population source _i_ to a recreation site destination _j_, where the total visits to the sites are broken down by the origins (usually place of residence) of the visitors to each. The V_{ij} can then be related to such variables as the size of the population in origin area _i_ (P_i), socioeconomic characteristics of origin _i_ (E_i), size, attractiveness or other characteristics of the resource _j_ (A_j), and a measure of the substitute recreation opportunities to site _j_ available to potential users in origin _i_ (S_{ij}). Parameters can be estimated for such an expression using visitation data from existing recreation areas usually by using fairly straightforward statistical techniques but with appropriate care being given to complying with the assumptions of the methods. The expression can then be used to estimate visitation to other areas. Estimates of how the attendance at these sites or another site may be expected to change over time, given changes in population characteristics and in supply configurations in the region, can also be made.

Any number of factors might be considered if there is some plausible basis for inclusion. This last qualification forestalls inclusion of spurious correlations that have no causal connections to the relations at hand but that by chance or by some unrelated reasons just happen to be correlated. Their inclusion would obscure the effects of the more relevant variables and could lead estimates far astray. Table C-1 provides a list of some factors known to influence recreational use.

The procedures required to develop a regional use estimation model are exemplified in work conducted by Brown and Hansen (Vols. III and V, 1974) to develop models for the Sacramento Region and the Southwestern Region. As

Table C-1
Factors Related to Recreation Use
(From Clawson and Knetsch, 1969)

1. Factors relating to the potential recreation users, as individuals:

   a. their total number in the surrounding tributary area.

   b. their geographic distribution within this tributary area - how many are relatively near, how many are relatively far, etc.

   c. their socioeconomic characteristics, such as age, sex, occupation, family size and composition, educational status and race.

   d. their average incomes, and the distribution of income among individuals.

   e. their average leisure and the time distribution of that leisure.

   f. their specific education, their past experiences, and present knowledge relating to outdoor recreation.

   g. their tastes for outdoor recreation.

2. Factors relating to the recreation area itself:

   a. its innate attractiveness, as judged by the average user.

   b. the intensity and character of its management as a recreation area.

   c. the availability of alternative recreation sites and the degree to which they are substitutes for the area under study.

   d. the capacity of the area to accommodate recreationists.

   e. climatic and weather characteristics of the area, the latter during the period under study.

3. Relationship between potential users and the recreation area

   a. the time required to travel from home to the area, and return.

   b. the comfort or discomfort of the travel.

   c. the monetary costs involved in a recreation visit to the area.

   d. the extent to which demand has been stimulated by advertising.

accomplished in that study, the major components of regional model development are: visitor surveys, factors relating to use, and development of the use estimator equation.

Visitor Surveys

Model development is based on recreation use data. Brown et al. (1974) is an example of a source on usage. It provides data for 52 reservoir projects in seven Corps districts during a four-year period, 1966 through 1969. The method of collection serves as a guide to collecting data if a previously compiled database is not to be used. The visitor surveys were conducted on a sample basis in which recreational users were interviewed at the site and questioned on activity participation, trip origins, and the number of persons in the party. The data were collected from both day users and overnight visitors. A detailed discussion and evaluation of the survey procedures are provided in Crane et al. (1974).*

The origins of the visitors were classified into area groupings based primarily on county or county census division. Although this scheme is somewhat arbitrary, the origin designations matter little, and using census boundaries offers greater convenience for compiling data on population characteristics. Some earlier analyses have used concentric rings around sites as the units of observation. The county units, however, introduce more variation in the data, allowing more meaningful, locationally specific variables to be measured.

As distance from the reservoir increased, the size of the areal unit of resident populations was also allowed to increase; that is, for areas close to each site a single county or part of a county was used as an observation, but, for areas further removed, the counties were grouped together. The number of areal units taken as being the points of origin or observations for each lake varied.

Factors Related to Use

The main intent of the analysis is to quantify the relationship between the number of visitors going to each of the surveyed lakes from each of the origin areas and those factors responsible for the observed differences. A number of independent variables are used in an attempt to explain the variation in the observed visit numbers from each origin to each lake. For example, for their Sacramento Region model, Brown and Hansen (Vol. V, 1974) used four variables which, although they did not offer a complete explanation of visitor behavior, yielded a reasonable formulation with considerable predictive ability for the type of recreationist involved. The four variables were:

D = Road mileage. The first and most important variable was the road mileage form the areal unit of origin to the lake. For purposes of measurement, the origin was taken to be the population centroid of the area.

*Improvements to these procedures have been developed through research conducted within the Corps Natural Resources Research Program by the USAE Waterways Experiment Station.

P = Population of the areal unit. Simple population totals were used with the expectation that more use would originate from areas having a greater population, all else being equal.

A = Size of average recreation pool . A size indicator was deemed necessary to account for the increased capacity of the different lakes. This measure of attractiveness of a recreational site is crude, but for this type of area it sufficed. Several alternative size or capacity variables were included, but water surface area at average recreation pool provided to be as good as others in this case. For other areas and for different comparisons, some further definition of attraction might be more useful. It should be noted, that with increasingly refined inventory or site information, it would be expected that increasingly fine distinctions could be made in user response.

S = Index of substitute recreation opportunities. This index was included to account for the substitute recreational opportunities of a similar nature available to residents of different origin areas. It would be expected that if readily available substitute areas were accessible, than fewer visitors would be expected to make the trip to a lake in question. This index took into account other lakes and reservoirs, the value being larger as the number, size, and proximity of the lakes available to a population increased.

Use Estimator Equation

With these four variables, an equation was derived by multiple regression methods on the basis of the observed visit patterns. After several alternatives were tried, the equation finally used for the Sacramento Region was as follows:

$$V_{ij} = -4577 - 2.52(P_i/D_{ij}) + 0.0013(A_jP_i/D_{ij}) + 27(P_i/D_{ij}S_{ij})$$

which, after rearranging terms, can be written as:

$$V_{ij} = -4577 + (P_i/D_{ij})\ (-2.52 + 0.0013A_j + 27/S_{ij})$$

Where V_{ij} is the annual number of recreation visits form area of origin $\underline{i}$ to lake $\underline{j}$, P_i is the population of areal unit $\underline{i}$, D_{ij} is the road mile distance between the area of origin $\underline{i}$ and the lake $\underline{j}$, A_j is the average recreational pool size of lake $\underline{j}$, and S_{ij} is the index of substitute lakes available to area $\underline{i}$ for lake $\underline{j}$.

For the Sacramento Region, statistical results of the analysis indicate that all coefficients are significant at the one percent level, and the equation explained approximately 92 percent of the variation in visitation among the observations. In other words, all but eight percent of the variation in the individual visitation totals among the 168 observations are explained by this equation.

Test of Predictive Capability

The prediction capability for the individual observations (i.e., the V_{ij}) is the primary test of how well it can be expected to predict for a new lake. Although the main point is to determine more general effects that would have the most validity for prediction purposes, it is also instructive to compare the total number of visitors to the individual lakes in the original sample with the predicted totals, which are simply the V_{ij} summed over all areas or origin for each single lake.

Actual and Predicted Day Use Visitation to Seven California Lakes

Lake	Visitation Estimated From Survey	Predicted Visitation
Isabella	845	839
Pine Flat	493	612
Success	481	430
Kaweah	289	236
New Hogan	243	272
Black Butte	161	164
Engelbright	109	67

As indicated above, the regional model provides a fairly accurate prediction of the annual day use visitation for each of the seven lake projects in this sample. It seems reasonable therefore that the equation could be used with considerable confidence to predict visitation at a new or proposed lake in the region.

Data requirements

Development of regional use estimation models requires that data from existing areas be systematically collected. The major requirement is that the data on the use and the users of a range of types and locations of facilities span the types and locations of those proposed areas for which estimates are to be made. A series of surveys at existing sites can provide such basic data which would normally include total use, timing and patterns of use, the characteristics of the users, and their areas of origin.

Methods of data collection that have proven fairly satisfactory involve a very short handout questionnaire or interviews of a small sample of randomly selected users of the different recreation areas. It is important that fairly reliable total visit statistics be obtained for each existing area investigated. This can usually be done satisfactorily with judicious use of traffic counters at most water-based recreation areas. If totals are collected throughout the season, samples for questionnaires or interviews need be drawn only on a few days, on both weekends and weekdays, as patterns are likely to vary greatly between them.

The questions asked may be similarly limited. The major concerns are the origin and purpose of the trip and limited information about the party. A representative range of areas, facilities, and locational proximities should be covered in such surveys. Fully adequate methods are available that are relatively inexpensive, entail a minimum of difficulty at the site and to the user, and yield meaningful results (Mischon and Wyatt, 1978). Many such surveys are currently being conducted at Corps lake projects as part of their visitation reporting requirements (Engineer Regulation 1130-2-430).

Applying an Existing Regional Model

If an existing model is to be applied, the steps for its implementation are fairly straightforward:

1. Determine the market area for the proposed project. This is the area from which project users may be expected to originate. If the market area is divided according to census boundaries (e.g. counties), it will be easier to compile demographic data for use in subsequent steps.

2. Collect data for each of the variables in the regional model use equation for each origin area and for each year for which a use estimate is to be calculated.

3. Calculate use from each origin area for each year.

4. Aggregate use from each area to get the estimated annual use.

Application of the previously described Brown and Hansen (1974, Vol. V) regional model to a given year of estimate, involves the following steps which are briefly described here. Although the general procedures would be similar for other applications, specifics (e.g., definition of area of origin and variables included) would differ with each application.

Step 1. Delimit the areas of origin for the proposed project

As an areal unit, the county is an efficient and convenient basis for data processing. However, because of shape irregularities, it may be more useful to cluster counties in sets for defining the areas of origin. By this concept, counties are divided in County Census Divisions (CCD) and then clustered to form more meaningful observation units.

To delimit the sets about a proposed project, first locate the project on a map containing CCD boundaries (available from the U.S. Bureau of Census) and sketch on the approximate 50, 150, and 250 road mile boundaries. Next, adjust the zonal boundaries to coincide with county or CCD boundaries. If a zonal boundary intersects a county such that a significant portion of its population lies in more than one zone, the zonal boundary should be adjusted to follow the appropriate CCD boundaries. However, if a majority of the population lies within one zone, the zonal boundary should coincide with the county boundary so that the entire county lies within the appropriate zone.

The three zones are next divided into the appropriate number of county sets. The first zone should contain approximately four county sets and the remaining two zones approximately ten each. The sets are formed by grouping contiguous counties or subcounties which have similar characteristics, while keeping in mind the approximate number of sets desired within each zone. The delineation of county sets is somewhat arbitrary and different planners would probably not construct the sets exactly the same. However, if the general guidelines are followed, the final use estimates should be very similar even with different set descriptions.

<u>Step 2. Compute the measures of the variables included in the model for each area of origin for the year of estimates</u>

The measures of the factors affecting use are first derived for the individual counties and subcounties within the general market area in the following manner:

Population: for counties - the projected county population for the year of the estimate; for subcounties - the proportion of the county population residing in the subcounty during the most recent census times the projected county population for the year of the estimate.

Distance: the road mileage between the largest city in the county or subcounty and the nearest access at the project.

Project Size: average recreational pool size in acres.

Alternative Index: the alternative index is computed for each area of origin and is estimated by the following:

$$S_{ij} = \left(1 + \sum_{k=1}^{n} \frac{\ln a_k}{d_{ij}}\right)^2 \text{ for all}$$

$$\frac{\ln a_k}{d_{ik}} > \frac{\ln a_j}{d_{ij}}$$

where the subscripts <u>i</u>, <u>j</u>, and <u>k</u> are for the areas of origin, the proposed project and the substitute facilities; <u>a</u> is measured by the water surface acres at gross pool; and <u>d</u> is again the road mileage from the largest city in area <u>i</u> to the nearest access at lakes <u>j</u> or <u>k</u>.

The county set measures are then derived from the county data in the following manner:

Population: simple sum of the projected populations of all counties and subcounties within the set.

Distance: population weighted average of the distance of the counties and subcounties within the set.

Project Size: average recreational pool size.

Alternative Index: mean of the alternative indices of all counties and subcounties within the set.

For project planning purposes one annual estimate of recreation use is usually made for each decade throughout the life of the project. County set populations are projected for the year of each of these estimates, the measures of the other factors can either remain constant or be adjusted to account for anticipated changes in the highway network or in the availability of substitute opportunities.

Step 3. Substitute the appropriate measures into the estimator equation

For each annual estimate the measures of the factors affecting use associated with each area of origin are substituted into the estimator equation and the results summed over all areas of origin.

Step 4. Adjust the result to account for camping use and for any unique characteristics of the project or its market area not accounted for by the estimation

Some adjustments may need to be made to the use estimates derived form the estimator. One would be to account for measures of variables for the proposed project that may be outside the range of those from which the model was developed. For example, assume the proposed average recreation pool size of a project being evaluated was larger than any of the pool sizes of the projects from which the regional model was developed. To assist in adjusting the initial use projections, the estimates are recomputed with all measures the same except that the average recreation pool is assumed to be the size of the largest lake used in building the model. The expected day use for the proposed project should then be between the estimates calculated for the size of the proposed project and the size of the largest project in the model. Using these two estimates as guides, a final estimate is made of the day use expected at the proposed lake.

Another adjustment that may be needed is to account for use not considered by the model. The Sacramento regional model was for day use only and an adjustment to account for camping is required. To illustrate this, assume for example that camping use is estimated to be equal to 10 percent of total use, as derived from comparison of survey data from existing lakes. The day use estimate would then be divided by .90 to obtain the final, total use estimate for the year of estimate.

APPENDIX D: SIMILAR PROJECT APPROACH FOR USE ESTIMATION

APPENDIX D: SIMILAR PROJECT APPROACH FOR USE ESTIMATION

Similar Project Approach

This approach is based on the concept that recreation demand for a proposed project can be estimated from observations of visitation patterns at one or more existing projects that have similar resources, operation, and anticipated recreation-use characteristics. One variation of the methodology uses a per capita use curve or function from one or more existing projects with similar resource, operation, and user characteristics as those for the proposed project for which estimates are to be made. One inventory of such curves and associated data for 52 lake projects is contained in Brown, et al. (1974). That report also gives a detailed discussion of how to utilize the similar project approach for estimating use at proposed lake projects. The procedures described in that study are also applicable to non-lake projects as long as appropriate per capita curves from similar, existing non-lake projects are first developed.

An overview of the methodology adapted from Brown, et al. (1974) is provided below. As described, the methodology assumes per capita use curves are either available only for day use recreation or can be constructed; guidance is provided to adjust for camping use. If per capita use curves are subsequently developed for camping use, estimates of such use could be derived directly form the curves using the same general procedures.

The similar project prediction method is comprised of the following eleven steps.

Step 1: Evaluate Characteristics of Proposed Project

The characteristics to be considered in evaluating a proposed project are summarized in Table D-1. If needed, a complete description is given in Brown, et al. (1974). Information is gathered on these characteristics and, where necessary, evaluations made (e.g. quality of access routes) so that comparisons can be made with like data from the inventory of similar projects.

Step 2. Select similar project(s)

An existing similar project or projects should be selected by comparison of the project characteristics. When possible, consideration should be given to selecting a similar reservoir near the site of the proposed reservoir. After selection of the similar project(s), evaluation of the day-use market area conditions may provide further information which will modify this selection (Step 5). The planner should be alert to unusual socioeconomic characteristics on a broad scale, (e.g., a large area predominantly composed of retirement communities). Another important consideration is alternative water-oriented recreation opportunities. Information about alternative opportunities such as the latest attendance estimates, attendance trends, kinds of recreation facilities, expected development level, and degree of saturation should be obtained for proper evaluation.

Table D-1

Summary of Characteristics to Consider in Evaluating a Proposed Project and in Selecting a Similar Project

Characteristic	Considerations
Reservoir Area	Reservoir Size: Surface area of average recreational pool Miles of recreation shore Reservoir Basin Topography: Land area and gradient
Accessibility	Existing Roads Planned Improvements to Existing Roads Planned Addition of New Roads Number of Major Access Routes Quality of Access Route Number of Access Points Length of Shoreline Accessible by Auto
Reservoir Fluctuations	Seasonal and Annual Drawdown (extent, frequency, duration) Bank Slope
Alternative Recreation Opportunities	Water-oriented Outdoor Recreation. Available to Market Area Population Number of Opportunities User Capacity Quality of Recreation Experience Relative Price of the Recreation Experience
Recreation Facilities	Investment, Campsites, Boat-launching ramps, etc.
Activity Limitation	County and State laws or regulations Water Temperature Water Quality Forest Fire Hazard Size of Project Weather Conditions (e.g., length of season)
Activity Potential	Reservoir Area Quality Utility of Water for Specific Activities Fishing Potential

The initial selection of a similar project from which to obtain per capita use rates should be based on approximate reservoir size in terms of the surface area of the average recreation pool. In general, the reservoir most similar in physical characteristics and water-oriented competition should serve as the similar reservoir. If the planner has difficulty in obtaining a similar project based on comparison of average recreation pools, the next smaller and next larger projects should be examined. In the absence of a single most similar project, it may be desirable to use the characteristics and data from two or more similar projects.

Step 3. Evaluate similar project(s) day use market area

The day use market area is considered to be the area from which some specified percentage of the annual day use visitation is drawn. The extent of this area is dependent upon what percentage of annual day use is used and the arrangement of major and secondary access routes with respect to the project(s). Road mile distance zones are determined and a per capita visitation rate by distance zone is calculated. The day use market area corresponds to the zone at which the desired percent level is reached or exceeded.

Step 4. Select (or construct) a per capita use curve for similar projects(s)

Per capita use curves for 52 reservoirs in seven districts are contained in Brown, et al. (1974). Guidance on the selection of a curve from among the 52 is also included in that report.

If the similar project(s), is not among the 52 for which per capita use curves have been developed, then a curve will need to be constructed. The process for curve construction is as follows:

a. The day use market area is divided into distance zones (e.g., the first 50 miles from the project might be divided into zones of 10 miles width, while the remainder of distance out to the outer boundary of the market area might be divided into zones of 25 miles width). The zone widths are measured in road miles determined by measuring the road mile distance along major and secondary access routes from the visitor's origin to the reservoir.

b. An estimate of the population within each zone is made.

c. An estimate of the aggregate annual recreation day use of the project by each zone is made.

d. A zonal per capita use rate is calculated for each zone by dividing the annual use by the population. This yields an estimate of the number of visits to the project for each person in a particular zone in one year.

e. A per capita use curve is obtained by plotting the zonal per capita use rates against zonal distance from the project.

Step 5. Modify the similar project(s) per capita use curve to reflect the dissimilarities between the similar project(s) and the proposed project

The recreation use data from the similar project(s) is used to adjust the similar project per capita rates to more nearly fit the prospective project. The difference among the per capita rates of day use for various projects may be associated with differences in either project or population variables. Under ideal conditions, when the proposed and similar project are alike, no adjustment would be required. However, it is more likely that dissimilarities will exist, and if they do, they will have an effect upon the magnitude and the slope of the per capita curve. The variables given in Table D-1 should be examined carefully for differences between the similar project and the project under study. Adjustment in per capita rates should be based upon differences in these variables. However, it should be noted that extremes in any of the variables (e.g., polluted water unfit for contact) may affect recreation use out of proportion of their normal influence.

Step 6. Determine project market area population for initial year of operation

The day-use market area for a proposed reservoir project under study is established using the existing market area of the similar project with appropriate adjustment by the planner based on experience and personal knowledge of the area. The market area of the proposed project need not have a minimum 50 mile radius; the area can and often will be smaller or considerably larger depending on the location of the major using population. If, when establishing the counties to include in the market area, there is some doubt as to where the boundary should be drawn, the general criteria for selection is inclusion of those counties which have approximately one-half of their population and/or land area within the tentative day-use market area boundary.

Step 7. Derive the per capita use rate for counties in the proposed project's market area

For each county from Step 6:

a. measure the mile distance form the proposed project to the center of the most populated city within the county. (The most populated city serves as a proxy for the centroid of county population).

b. using the modified per capita use curve obtained in Step 5, read off the rate associated with the mile distance measured for the county. This is the per capita use rate for that county.

Step 8. Calculate the annual day use from each county

This is done by multiplying the county population (Step 6) by the derived use rate (Step 7).

$$\boxed{\text{County Annual Day Use}} = \boxed{\text{County Population}} \times \boxed{\text{County per capita use rate}}$$

Step 9. Calculate annual day use for the project

This is done by summing annual day use calculated for each county in Step 8.

Step 10. Calculate total initial annual use for the proposed project

If recreation at the proposed project is to consist only of day use activities, then the annual day use estimate calculated in Step 9 is taken as the total initial annual use estimate.

If recreation at the proposed project is to include camping, then the estimate derived in Step 9, is only a portion of the total use,

$$\boxed{\text{Total Use (100\%)}} = \boxed{\text{Percent Use Day Activities}} + \boxed{\text{Percent Use Camping}}$$

and the portions of the total use that are expected to be given to camping and day use must be determined before an estimate of total initial use can be made.

a. Determine the percent of use given to camping at the similar project and use this as the percent of use given to camping at the proposed project.

b. Figure the estimated total initial use at the proposed project as:*

$$\boxed{\text{Total Initial Use}} = \boxed{\text{Total Day Use (Step 9)}} \div \boxed{1.00 - \frac{\%\ \text{camping}}{100}}$$

* A similar adjustment would be made to the initial day use estimate if the market area boundary was defined to include the origins of less than 100 percent of the potential day users. This adjustment would be made before the adjustment for camping use.

APPENIDX E: CAPACITY APPROACH FOR USE ESTIMATION

APPENDIX E: CAPACITY APPROACH FOR USE ESTIMATION

Capacity Method

In order to apply the Capacity Method, it is first necessary to demonstrate that there is an unquestionable need for recreation in the market area. In some cases this may be obvious before conducting a needs assessment. In other cases, a need for recreation may not be clearly recognized until completion of Step 4 ("Determine the Without Project Condition") of the planning framework.

There are essentially two steps in the capacity method:

Step 1. Calculate the project recreation design load.

With the capacity method the design day load is defined as the number of visitors that could be supported by specified resources or facilities on the design day. It is a function of the instantaneous capacity of a unit of the facility or resource, its daily turnover rate (i.e. how often it would be used by different visitors or groups of visitors) and the number of units being considered. Information on capacities and turnover rates are available from site development and facility standards which are part of agency planning and design criteria and from previous recreation surveys from similar projects that account for daily use patterns.

Design Day Load	=	Instantaneous Capacity per Unit	x	Daily Turnover Rate	x	Number Units

Step 2. Convert design day load to estimated annual use.

The design day is usually considered an average weekend day during the peak season of use for the particular facility or resource being considered. The design day load can, therefore, be converted to an annual use estimate by accounting for the number of weekend (usually including holiday) days during the peak season, the proportion of peak season use expected on weekend days, and the proportion of annual use expected during the peak season. Information on peak season use patterns can be obtained from previous visitor surveys from similar projects or from agency planning and design standards.

Use	=	Design Day Load	x	Average Number Weekend Days in Peak Season	+	Proportion Peak Season Use Expected on Weekend	+	Proportion Annual Use Expected During Peak Season

APPENDIX F: VALUATING USE WITH TRAVEL COST METHOD

APPENDIX F: VALUATING USE WITH TRAVEL COST METHOD

Travel Cost

The basic premise of the travel cost method is that per capita use of a recreation site will decrease as the out-of-pocket and time costs of traveling from place of origin to the site increase, other things being equal. Application of the travel cost method to estimate value requires that an estimate of use has been made, with a gravity or similar type model that includes distance or travel cost as an explanatory variable. With this information, the method enables an estimation of: (a) expected use, (b) a demand function for recreation at the site, and (c) the NED recreation benefits of the site. The travel cost method essentially consists of three steps:

1. estimating use
2. deriving a demand curve
3. computing benefits

Estimating Use

As noted in Chapter III, there are two methods that are appropriate for providing a gravity type use estimator for employment in the travel cost method: either a Use Estimating Model or the Similar Project Approach. Since the travel cost method builds directly on gravity type use estimation models, they are the preferred means for estimating use. Appendicies C and D provide details on procedures for implementing both of these use estimation techniques, this appendix presents a brief statement on their make-up.

A use estimation model applies a use estimating equation that is derived from observations of use patterns at existing projects and that serves to relate use at a proposed site to distance traveled, socioeconomic factors, the characteristics of the site, and alternative recreation opportunities. Use estimating equations have a firm empirical base because they are based on actual use patterns observed at existing recreational facilities. Because they explicitly incorporate the important factors that influence use, they are statistically more accurate than other use estimating techniques. Since a use equation is based on data collected at existing sites, it is assumed that the proposed project will offer similar recreation opportunities and will be operated under similar management practices as those at the existing sites. Major differences will be accounted for by the quality variables in the use equation, but the planner may have to make some adjustments to allow for characteristics that are unique to the project under study. Such adjustments must, of course, be justified.

The objective of the similar project approach is to obtain as close a match as possible with respect to location, type, size and quality of project and user characteristics between a proposed project and an existing project for which a gravity type use estimator has been derived. The level of professional judgement required for this use estimation method can be substantial because it is necessary for the selection of a similar project as well as for the modification of existing use estimators to reflect dissimilarities between the "similar" and the proposed projects.

Deriving a Demand Curve

The travel cost method assumes that increasing the distance from areas of origin to the site is equivalent to increasing the cost or price of recreation at the site. The procedure consists of calculating total use at different incremental distances (prices). The process is based entirely on the use estimator. The result is a demand curve for the site being evaluated that relates "prices" to total visits. Distances are converted to dollar values using per mile conversion factors reflecting both time and out-of-pocket travel costs. The area under the demand curve plus any user charges or entrance fees measures the recreation benefits attributable to the site. The general procedures for applying the travel cost method are provided in the following paragraphs. More detailed guidance, including illustrative examples, is provided in Appendix G.

The estimate of recreation use for a project derived from application of a per capita use curve or regional estimator yields an initial point on a resource's demand curve. This point is the quantity of use that would be demanded considering all costs that would be incurred by the users to participate including user charges or entrance fees (if any). This point is defined as the zero price point for the purpose of deriving the users' consumer surplus or the amount they would be willing to pay but do not have to pay to utilize the resource. (As discussed in Chapter II, entrance fees and user charges are a part of project benefits although they are not a part of the user's consumers surplus.)

To find sufficient points to determine the entire demand curve, it is necessary to make incremental changes in the price of recreation and to measure the quantity of use that would be demanded given these changes. Unfortunately, it would be impractical to actually make incremental increases in fees at the projects and to then observe the changes in use that occur. However, the results can be approximated with the use of a gravity type use estimator and a proxy for price.

With the travel cost method, the use estimator includes measures of the distance between the project and areas of origin as one of the independent variables influencing use. After the initial (zero price) use estimate is made, increments are added to the distance measurement between the project and each area of origin. The increments are equivalent to moving the project further and further from the users, requiring them to pay more and more in travel time and travel costs to reach the project.

As distance is increased, use decreases, and for each increment in distance a new use estimate is computed with the use estimator. The new use estimates are the various quantities of recreation that would be demanded at increasing prices. To determine the price at which these quantities are demanded, it is only necessary to convert the incremental increases in distance to the costs (both travel and time), that would be incurred by the recreationists if they were required to travel the additional mileage.

Proxy for Price

Variable or out-of-pocket costs per mile to operate an automobile are used for the travel cost portions of the proxy for price. Out-of-pocket costs are used since these are the costs potential users would be most cognizant of when making a decision whether or not to visit a particular resource area. Such fixed costs as depreciation, insurance and registration should not be included since they would generally not affect the potential users decision as to whether or not to travel the additional mileage for recreation purposes.

The conversion of mileage to price is readily accomplished by the use of published results from studies conducted periodically by the U.S. Department of Transportation, concerning the average cost of operating an automobile. Current data on average operating costs are available from the U.S. Department of Transportation.

Some adjustments may be required, however, before these costs can be used as the proxy for price. First is an adjustment for round trip mileage. If the distance measure used in the per capita use curve or regional estimator is the one-way mileage between the project and the areas of origin, then the costs should be doubled to account for the recreation user incurring the variable costs while traveling to and from the project. In addition, since more than one user may arrive in each vehicle, a second adjustment may be needed to distribute the travel costs of the trip between the number of users within each vehicle. This can be readily accomplished by the use of the average number of users per vehicle determined from the data from the survey of existing sites that was used to develop the per capita use curve or regional estimator.

An Adjustment for the Disutility of Time. The use of just the variable travel costs in the development of the demand schedules ignores the disutility of time which is an important consideration to the recreationist in overcoming distance. When time is ignored the demand schedules are constructed under the hypothesis that increasing distance decreases use only because there is then a higher money cost. However, the additional time required to travel the increased distance would seem to be an equal or greater deterrent to the recreationist than the out-of-pocket money costs. The exclusion of the time factor introduces a consistent bias in the derived demand schedule, shifting it to the left of the true demand schedule and resulting in an underestimation of the recreation benefits.

Unfortunately, there is normally a high correlation between travel cost and travel time. People from more distant areas of origin generally must spend more time as well as more money getting to a site than people who live closer. It is, therefore, often not possible to estimate the separate effects of the two variables in use estimation models. Ignoring the effect of time during benefit evaluation, however, will result in a consistent bias, an underestimation of the benefits.

One procedure which is often used to accommodate consideration for the disutility of time is to assume a known tradeoff between time and money. No universally accepted formulation of this tradeoff has yet been established and empirically tested. A linear tradeoff is most widely used and is recommended until further research validates a more precise formulation.

A linear tradeoff between time and money assumes a constant opportunity cost of travel time and implies a constant willingness to pay to avoid the time required to travel to distant recreational sites. In a review of empirical studies of the opportunity cost of travel time, Cesario (1976)* found that the estimated value of nonwork travel time is between 1/4 to 1/2 of the wage rate. Cesario and others have used 1/3 the average wage rate for the opportunity cost per hour of travel time for adults and 1/12 the average wage rate for the opportunity cost of travel time for children under the age of 12. These values are suggested for use by P&G but other estimates of the value of time can be used if supported by empirical evidence.

P&G also recommends that onsite time costs as well as travel time costs should be included in the derivation of the total willingness to pay for access to the site. As noted by Knetsch and Cesario (1976) and reiterated by Mendelsohn and Brown (1983), the value of onsite time should not be included unless it is reasonable to assume that the marginal utility of onsite activities is zero. These onsite costs are not related to the individual's marginal cost of obtaining the site and, therefore, should not be included as part of travel cost.

Computing Benefits

The final computational step in the travel cost approach is to measure the area under the demand curve. This area is equal to the amount users would be willing to pay but do not have to pay for the opportunity to participate in recreation at the resource being evaluated. Computationally, this area is approximated by multiplying the average use estimates associated with each increment in price times the proxy (travel and time cost) for the price increment and summing over all such increments. Any user charges or entrance fees that have been incurred by the user should be added to this value to determine the gross value of the resource associated with the specified management option.

As previously noted the travel cost approach can be used for evaluating either the with or without project conditions as long as a gravity type use estimator is available for estimating use under the specified condition. When evaluating the without project condition the estimate is of the value of the recreation that would be lost at a site if a water resource development project is undertaken. If evaluating a with project alternative, the estimate is of the value of the new recreation opportunities that would be created. If a gravity use estimator is not available for evaluating either the without or one of the with project conditions, then one of the techniques in other portions of this manual should be utilized.

The procedure described above is applicable for any type of activity or groups of activities for which use can be described by a gravity type estimating model. The level of disaggregation of the estimator, for example

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* References are given in the bibliography and literature cited section following the main text.

day use versus overnight use or sightseeing versus other day use activities, is dependent upon the specificity of the survey data and the model formulation.

Documentation

In order to provide adequate information for updating or verifying the computational process, it is important that adequate documentation be retained of the data and model used. As a minimum such documentation should include:

(1) The per capita use curve or regional estimator utilized to estimate use.
(2) Whether one-way or round trip mileage is used in the use estimator.
(3) Delineation of the areas of origin used in the analysis.
(4) Population projections, time periods and sources for such projections used to estimate use.
(5) Variable travel costs and time period and source for such costs used to estimate benefits.
(6) Proxy used for evaluating time.

APPENDIX G: EXAMPLE OF THE APPLICATION OF THE TRAVEL COST METHOD

APPENDIX G: EXAMPLE OF THE APPLICATION OF THE TRAVEL COST METHOD*

The purpose of this appendix is to illustrate by hypothetical example the mechanics of the travel cost approach. It is not intended to be a detailed primer on recreation use estimation or benefit valuation. If at times the example seems overly simplistic, it is intentional. The objective is to illustrate use of the travel cost approach without clouding the presentation with other judgements and considerations (e.g., resource and social carrying capacity, accounting for substitute sites) that must be made no matter what benefit valuation approach is used. One advantage of the travel cost approach is that many of these considerations can be incorporated into the valuation process as familiarity is gained through application. Although the example is presented in a simplified and hypothetical nature, much of the data originated from a feasibility study prepared by the Buffalo District and an ongoing Campground Receipt Study (Curtis et al. 1982)** being conducted by the U.S. Army Engineer Waterways Experiment Station.

There are certain minimum types of information that are necessary to perform the calculations that the travel cost approach requires. These types of information and their most likely sources are presented in Table G-1. The example illustrates how this information is used.

Travel Cost Example: Day Use

For this example assume we are trying to estimate the potential recreation benefits for one alternative being considered during a feasibility study. The alternative is a multipurpose reservoir (MR) that would provide opportunities for both camping and day use activities.

As previously described in this report, the travel cost approach uses observations of visitor responses to varying travel distances to estimate what additional amounts (above the travel cost actually incurred) they would be willing to pay to use an existing or proposed recreation resource. Therefore, the first step is to determine whether or not an appropriate use estimation model (or the data to develop such a model) is available from similar projects. (For a more detailed discussion of the characteristics to consider when selecting similar projects, see Brown et al. 1974, pp. 7-10.)

Although no model was available for the MR, an existing project, Good Time Lake (GTL), is located in the same geographic region. GTL has similar resource attributes (e.g., size) as would the MR, but does not have fee camping areas. A local university conducted visitation and area of origin surveys the previous year at GTL. These data combined with population

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*Prepared by William Hansen and Dennis Propst, Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Dr. Propst was assigned to WES at the time under terms of an Intergovernmental Personnel Act Appointment with Shepards College, West Virginia.
**References are given in the bibliography and literature cited section following the main text.

Table G-1:
Information Needed in Travel Cost Approach

Information Needed	Sources
(1) Population by distance zone	1980 U.S. Census data (available from county planning offices, regional planning agencies, extension service of state land grant universities, libraries, etc.)
(2) Road mile distances	State highway maps
(3) Project visitation	(a) <u>Day use</u> - project surveys used to update load factors; surveys conducted by universities, state agencies, etc. Usually measured in units of recreation days use. For day use only, recreation days use = number of visits. Thus, recreation days use/capita = visits/capita. (b) <u>Camping</u> - project surveys used to update load factors; surveys conducted by universities, stage agencies, etc.; campground fee receipts (see discussion in text). Usually measured in units of recreation days use. For camping, recreation days use = visits x length of stay. Thus, visits = recreation days use divided by length of stay.
(4) Variable motor vehicle costs (see Table G-5).	U.S. Department of Transportation
(5) Average weekly earnings	1980 U.S. Census data; State Employment Offices; State, regional, or local planning offices.

information and road mileages can be used to develop the necessary use/distance relationships for using the travel cost approach to estimate day use benefits at the MR; additional data sources will be needed to derive the benefit estimates for camping.

Day Use Estimation for the Similar Project

To derive distance/use relationships for day use at GTL, we must first determine the market area and then divide this area into zones of varying distances. The market area will vary from project to project. One valid way of determining the total market area is to look at the visitation patterns, identified by visitor surveys. For example, data form the GTL visitation surveys indicated that 100 percent of the 633,130 total day use visitors were presently driving up to 125 miles to participate. The total market area was, therefore, defined as all counties within 125 road miles of GTL. This market area was divided into five 25-mile distance zones with use estimates by zone derived from the visitor survey (Table G-2).

Table G-2:
Good Time Lake Distance Zones and Annual Use Estimates

Distance Zones (miles)	Annual Day Use Visitors	Percent Distribution of Day Users
0-25	353,345	55.8
26-50	190,420	30.1
51-75	33,685	5.3
76-100	28,185	4.5
101-125	27,495	4.3
TOTAL	633,130	100.0

There is nothing sacred about the 125 mile cut-off or the 25 mile increments. Under appropriate circumstances increments of 10 city blocks, 10 miles, or 25 miles may be appropriate. Rarely are the increments in excess of 50 miles, but this does not rule out the possibility of having 100 mile increments, say, for very remote projects. Nor do the distance zones have to be the same size throughout the market area (see Brown et al. (1974) for an example). You could begin with relatively narrow zones near the project (10 miles each, say) and establish wider zones farther away (50 miles, say).

Next we must determine the population of each of the distance zones. The most efficient manner for doing this is to obtain population figures for each county in the market area and sum these figures according to the distance zones in which they are located. The criterion for determining into which distance zone the county falls is the road mileage along the most likely traveled route between each county's population center (usually the largest town or city) and the nearest recreation access area on the project. For example, a county whose population center was located 53 miles from the nearest recreation area on GTL would be included in the 51-75 mile zone for data compilation purposes.

You do not have to compile population data on a county basis. Larger counties or counties with large populations in more than one zone, can be subdivided by County Census Division (Brown and Hansen, Vol. III, 1974) or zip code areas (U.S. Army Engineer District, Sacramento, 1976) for more appropriate zonal allocations.

For GTL, the market area contains the following county distribution by origin zone:

Distance Zones	Number of Counties	Population by Zone
0-25	2	79,741
26-50	8	801,178
51-75	10	2,472,318
76-100	18	4,307,937
101-125	25	4,361,719

The final step in deriving the use/distance relationship is to determine the per capita use rate by zone. This is accomplished by dividing the zonal populations into the estimates of use originating from each zone. For GTL these are:

Zone	Annual Visitation by Zone	Population by Zone	Per Capita Use by Zone
0-25	353,345	79,741	4.4311
26-50	190,420	801,178	0.2377
51-75	33,685	2,472,318	0.0136
76-100	28,185	4,307,937	0.0065
101-125	27,495	4,361,719	0.0063

Day Use Estimation for the Alternative

To estimate day use for the MR it is necessary to determine the total market boundary, divide that boundary into areal zones of origin, estimate the populations of the zonal areas of origin, multiply the population of each zone or origin by the appropriate per capita use rate, and sum over all zones. Normally, the appropriate per capita use rate is found by first statistically estimating the use/distance relationship and then using that statistical relationship (plotted curve or equation) to estimate per capita use for varying distances at the project being evaluated.* However, when the market area for the alternative is divided into the same distance increments as for the existing similar project, the zonal rates from the similar project can be used directly. Although this latter technique simplifies the procedures, it is not as valid as the more rigorous statistical analysis.

*The technique for statistically estimating the use/distance relationship is illustrated in a later section of this appendix by way of example for estimating camping use.

Since the MR would be very similar to GTL in terms of types of day use facilities and geographic location, the same market area criteria (125 miles and 25-mile zonal boundaries) are used. The estimation of visitation for the MR using existing GTL per capita rates is summarized in Table G-3.

Table G-3:
Derivation of Expected Visitation to the MR

(1) Zone	(2) No. of Counties	(3) Base Year Projected Population	(4) Visits Per Capita for GTL	(5) Visits for the MR (3) x (4)
0-25	3	679,444	4.4311	3,010,684
26-50	7	491,958	0.2377	116,938
51-75	13	3,394,276	0.0136	46,162
76-100	15	4,425,762	0.0065	28,767
101-125	22	2,675,484	0.0063	16,856
			TOTAL	3,219,407

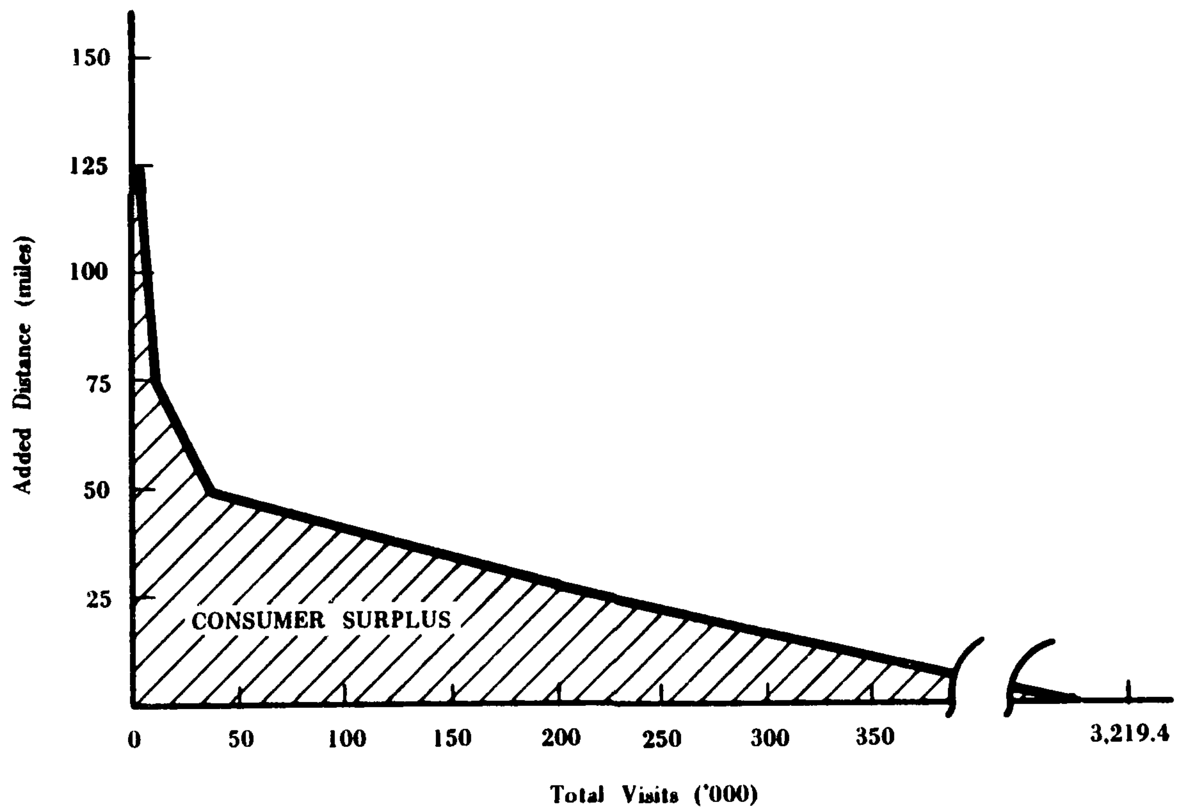
Day Use Benefit Estimation

The use estimate calculated above represents the initial point on the resource demand curve (sometimes referred to as the second stage demand curve): the amount of visitation that would be expected given the travel costs confronting visitors due to their existing geographical distribution about the MR. At zero additional distance from the site, we can expect 3,219,407 total visits for the purpose of using day use facilities (Figure G-1). As part of the process to derive benefits we must calculate the remaining points on the demand curve. Basically, this is done by estimating the amount of visitation that could be expected if visitors from each zone were confronted with the increased travel costs associated with the more distant zones.

To derive a second point on the demand curve we hypothetically increase the distance between visitors' origins and the MR by a constant amount and observe the effect that this increase in distance has on visitation. For the MR, we will use distance increments of 25 miles. This increase in 25-mile increments will continue until participation at the MR is zero. A distance shift of 25 miles is equivalent to the MR being moved 25 miles from the potential participants. The people living in Zone 1 would now be expected to visit at the same rate as the people living in Zone 2 (before adding the 25 mile increment). Thus the use rate for the population of Zone 1 would drop from 4.4311 to 0.2377 and expected visits would drop form 3,010,684 to 161,504 (679,444 x 0.2377). We do this for the remaining distance zones and sum the total visitation for each distance zone to compute the expected total visitation given a distance increment of 25 miles. This gives us an expected total visitation of 219,138 visits. Thus, the second point on our resource demand curve is 25 miles on the Y-axis and 219,138 visits on the X-axis.

Figure G-1

Second Stage Day Use Demand Curve for the MR



The calculations for the second point on the demand curve are:

Zone	Zone Population	x	Trips Per Capita	=	Estimated Visits
1	679,444		.2377		161,504
2	491,958		.0136		6,691
3	3,394,276		.0065		22,061
4	4,425,762		.0063		27,882
5	2,675,484		.0000		0
				TOTAL	219,138

The same procedure is repeated with added distances of 50, 75, 100 and 125 miles. At a distance shift of 125 additional miles, no day use participation occurs. People are no longer willing to travel that distance to use the site. Thus, the final point on the demand curve is: 125 additional miles distance and 0 visits. The results of these calculations are summarized in Table G-4. The first and last column of Table G-4 are the points used to plot the second stage demand curve (Figure G-1). The area under the curve in Figure G-1 is the visitors' consumer surplus or the additional amount they would be willing to pay but do not have to pay to use the resource. The project benefit is the area under this curve plus any entrance or user fees that would be collected (which, in this example, are zero for the day use visitors).

In order to estimate the dollar benefits under this curve, we must first convert the mileage increments into dollars. Incurred travel costs are made up of two components: out-of-pocket or variable motor vehicle costs and the value of travel time. The average vehicle cost per mile to the MR is 14.1 cents for 1981. The derivation of this amount is shown on Table G-5. Since there are 3.5 people per vehicle sharing these costs (based on survey results form GTL), the cost per mile per person is 4.1 cents.

Table G-4:
Second Stage Day Use Demand Schedule for the MR

Added Miles	Visits by Origin 1	2	3	4	5	Total Visits
0	3,010,684	116,938	46,162	28,767	16,856	3,219,407
25	161,504	6,691	22,061	27,882	0	219,138
50	9,240	3,198	21,384	0	0	33,822
75	4,416	3,099	0	0	0	7,515
100	4,280	0	0	0	0	4,280
125	0	0	0	0	0	0

Table G-5:
Motor Vehicle Cost Computation:
Cents/Mile (1981 Variable Cost)*

	Standard	Compact	Subcompact	Average
Maintenance Accessories, Parts and Tires	7.10	6.19	5.29	6.19
Gasoline and Oil	7.10	6.32	5.29	6.24
Taxes on Gas, Oil, Tires	2.06	1.67	1.41	1.71
			TOTAL	14.1

*1979 costs updated to 1981 values based on changes in the Consumer price Index for Transportation, private.

Source: U.S. Department of Transportation, Federal Highway Administration 1979. The Cost of Owning and Operating Automobiles and Vans, 1979. Office of Highway Planning, Highway Statistics Division.

The value of travel time per person is based on the average weekly earnings of the state in which the MR will be located. For 1981, this figure was $286.00 per week and was derived from the average weekly earnings for occupations covered by the relevant State's unemployment compensation law. For this particular state the $286.00 figure represented approximately 95 percent of the payroll workers. Assuming an average work week of 40 hours, the average wage rate is $7.15 per hour.

The adult value of travel time per hour is one-third of $7.15 ($2.38) while the value for children is one-twelfth of $7.15 (U.S. Water Resources Council, 1979). As indicated earlier, the vehicle load factor for day use activities at GTL was 3.5. Survey results indicated that, on the average, there were 2 adults per vehicle and 1.5 children. Thus, 57 percent of the total day use attendance (2 divided by 3.5) is by adults, 43 percent (1.5 divided by 3.5) is by children. The weighted average value of travel time per person per hour is calculated to be $1.61:

$$.57 (\$2.38) + .43 (\$0.60) = \underline{\$1.61}$$

The average vehicle speed is 45 miles per hour. Thus, the time cost to travel a 25-mile increment is approximately $0.90 (25 miles divided by 45 miles/hour) x ($1.61/hour) and $1.80 for the round trip. The vehicle cost per person for the 25-mile increment is $2.05 (50-mile round trip x $0.041/mile). The total cost for a 25-mile increment is $3.85 ($2.05 + $1.80). The total costs for the additions of 25, 50, 75, 100, and 125 miles are:

Increments (miles)	Round-trip Mileage	Time Cost of Travel ($)	Vehicles Cost/ Person ($)	Total Cost ($)
25	50	1.80	$ 2.05	$ 3.85
50	100	3.60	4.10	7.70
75	150	5.40	6.15	11.55
100	200	7.20	8.20	15.40
125	250	9.00	10.25	19.25

Plotting total cost per visit on the Y-axis and total visits on the X-axis provides the second stage demand curve converted into dollars. The line connecting the points is the demand curve. To estimate benefits you need to determine the area under this curve. You can do this by breaking the area under the curve into trapezoids, determining the area of each, and summing their areas (see Figure G-2). This amount ($7,217,358) is the total day use benefits for the [illegible] To calculate the average benefit per visit, divide total benefits by the number of visits estimated at zero additional miles (3,219,407):

$7,217,358 divided by 3,219,407 = $2.24 (average benefits per visit)

Travel Cost Example: Camping

Since GTL has no fee areas, we must select another similar project to develop a camping use estimate. The name of the second similar project is Q Lake. Although located over 500 miles from the alternative, Q Lake is extremely similar in terms of the number and type of camping facilities and expected visitation patterns.

Camping Use Estimation

We will obtain expected use rates for the alternative directly from a camping use equation (estimator) developed for Q Lake. As was true of day use, we need 3 pieces of information to develop the camping use estimate: county population figures, amount of campground use by county of origin, and road mile distances. County population figures were obtained from the "1980 Census of Population and Housing" for the states and counties surrounding Q Lake. Campground use data came from 533 fee receipts (see Figure G-3) collected during 1981 at Q Lake's only fee area. Road mile distances were obtained from state highway maps. All 3 data sets were entered and stored in a computer at WES. The data were tabulated using a program developed by Curtis et al. (1982) specifically for the campground fee receipts. Since this program allows visitation figures to be compiled according to campers' zip codes, it is easy to determine the source and amount of recreation area or project visitation.

Again, the first step in developing use rates is to define the market area for Q Lake. Remember that this market area now applies to camping only. As before, there are no set guidelines. You must use some judgment based on the characteristics of the area and visitation patterns. Data from the campground fee receipts indicate that 93.6 percent of the campers originate

Figure G-2

Day Use Benefit Estimation for the MR

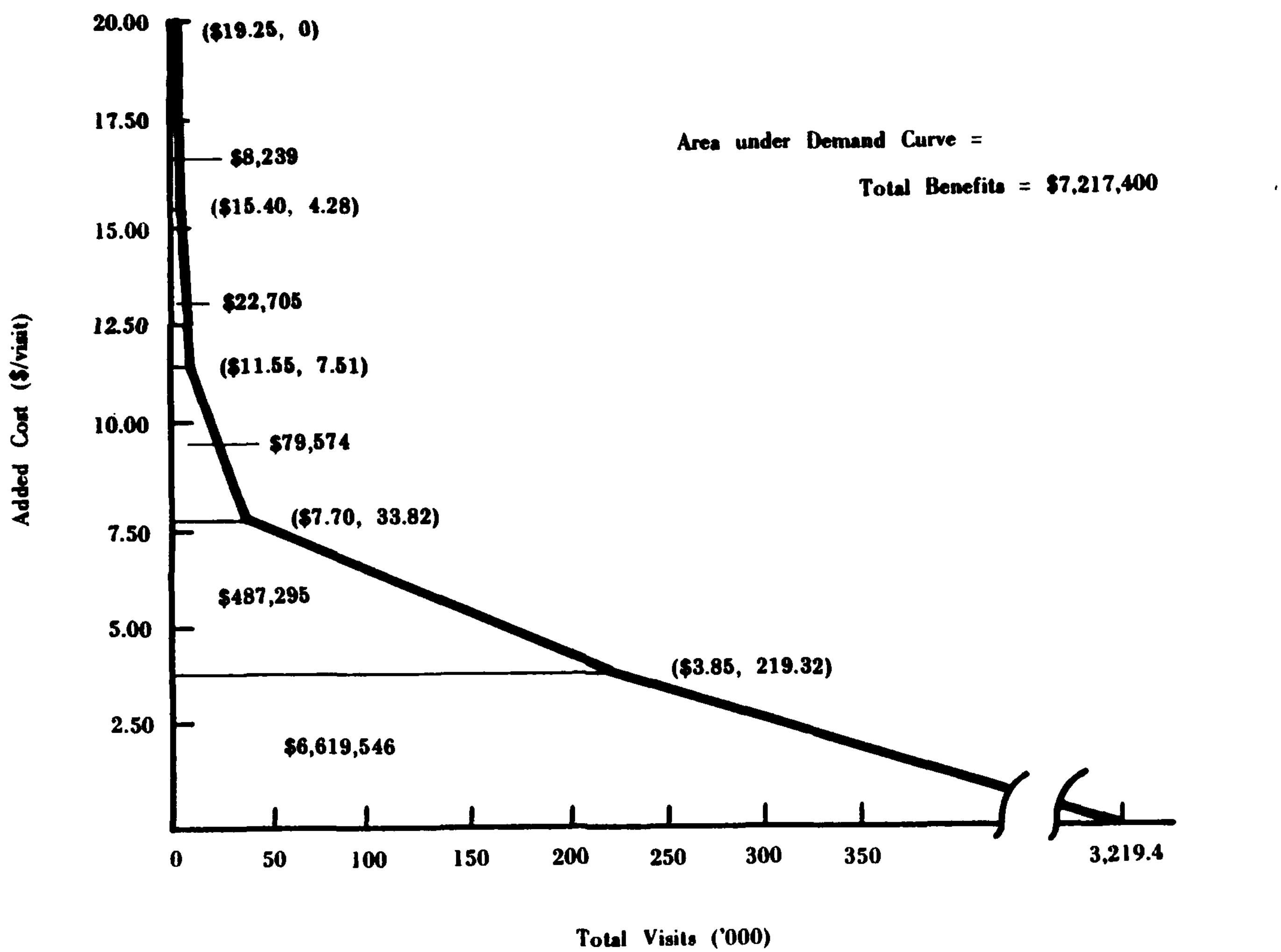


Figure G-3
Sample Campground Fee Receipt

U. S. ARMY--CORPS OF ENGINEERS

USER PERMIT

SERIAL NUMBER

SAMPLE

DISTRICT	PROJECT	REC AREA	SITE NUMBER	RENEWAL	CAR LICENSE	ZIP CODE
1 2	3 4 5 6 7	8 9 10	11 12 13 14	Y 15	STATE NUMBER	16 17 18 19 20

NAME OF CAMPER (OPTIONAL)	NUMBER IN PARTY	PRIOR VISITS	PRIMARY DESTINATION	STARTING DATE MO DAY YR	ENDING DATE MO DAY
	21 22	Y 23	Y 24	25 26 27 28	29 30 31 32

VEHICLE(S)	CAMPING EQUIPMENT	RECREATIONAL EQUIPMENT
33 ☐ CAR	39 ☐ TENT	45 ☐ POWERBOAT
34 ☐ TRUCK	40 ☐ POP-UP TRAILER	46 ☐ SAILBOAT
35 ☐ VAN	41 ☐ PICKUP CAMPER	47 ☐ BICYCLE
36 ☐ MOTORHOME	42 ☐ TRAVEL TRAILER	48 ☐ MOTORCYCLE
37 ☐ MOTORCYCLE	43 ☐ NONE	49 ☐ ORV (NONMOTORCYCLE)
38 ☐ OTHER		50 ☐ OTHER
		51 ☐ OTHER
	Y 44 ELECTRIC HOOKUP	52 ☐ OTHER

1. GOLDEN AGE NO. 2. GOLDEN ACCESS NO.	NIGHTS PD.	TOTAL FEE PAID	ATTENDANT
53	54 55	$ 56 57 58 59	

from within 150 miles of Q Lake. Thus, the total market area was defined as all counties within 150 road miles of Q Lake. The origins of the relatively few remaining campers that drove further than 150 miles were scattered over a variety of large distances from the lake.

For the camping estimate, it is advisable to select a market area that accounts for most of the visitation — 90 percent, say. This is because benefits accruing to those visitors originating outside the market area — 150 miles in this example — are difficult to determine. To do so, one would have to measure road mile distances from numerous counties located large distances from the lake. This would be a very time-consuming task. More importantly, it is highly unlikely that campers from such great distances would be using Corps reservoirs as primary destination sites. For Q Lake, 98.5 percent of the campers from within 150 miles were primary destination users. The travel cost approach is not usually used to estimate benefits by individuals using a project as a stopover on a longer trip. However, at the end of this example, we illustrate one method of adjusting benefits calculated by the travel cost approach. This adjustment method accounts for non-primary destination camping both within and outside of the 150-mile designated market area as well as primary destination users from beyond 150-miles.

The 150-mile market area was divided into fifteen 10-mile distance zones. Use estimates by zone (see Table G-6) were derived from the campground fee receipts. There were two major reasons for using the 10-mile zones:

a. Nearly half of the use originated from within 50 miles of Q Lake. Thus, finer gradations than 50 miles were deemed necessary.

b. Since there are 15 zones, there are 15 possible observations on which to base the regression analysis. For models with only one independent variable (the type we will be using in this example), 15 observations should be sufficient to produce a valid per capita use equation.

Population and use rates by zone were derived in a manner similar to that used in the day use example. These data are presented in Table G-6.

In this example, we will test 5 functional forms of the use estimation curve:

(a) $V/C = f(D)$
(b) $V = f(P/D)$
(c) $V = f(P/D^2)$
(d) $V = f(P/D^3)$
(e) $(V/C)\sqrt{P} = f(D\sqrt{P})$

where, V/C = visits per capita
V = visits
D = distance
P = population

Table G-6:

Q Lake Market Area Information

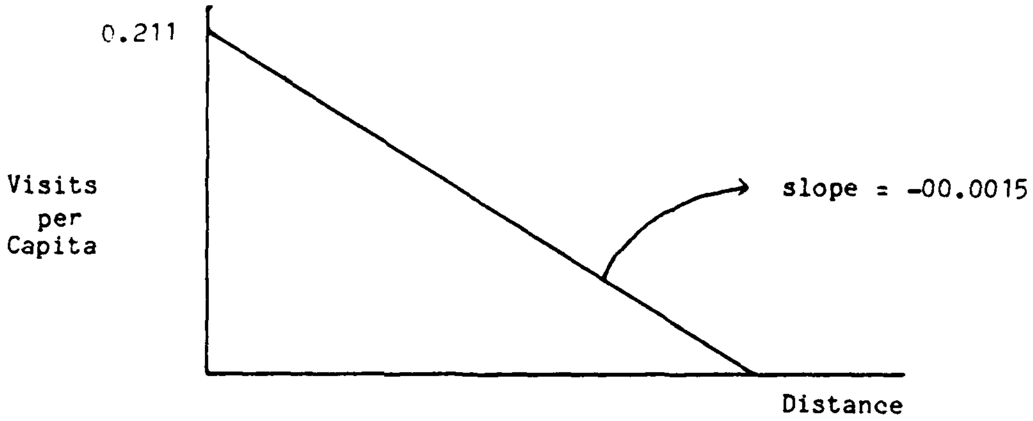
Distance Zones (miles)	Number of Counties	Zone Population**	Number of Camping Visits#	Visits Per Capita
0-10*	0	—	—	—
11-20*	0	—	—	—
21-30	3	59,829	498	.0083
31-40*	0	—	—	—
41-50	2	112.410	371	.0033
51-60	2	27,800	52	.0019
61-70	2	27,276	41	.0015
71-80	2	33,696	30	.0009
81-90	4	213,914	108	.0005
91-100	1	65,639	17	.0003
101-110	3	101,009	59	.0006
111-120	2	187,824	4	.0000
121-130	2	420,901	283	.0007
131-140	3	58,049	84	.0014
141-150	3	488,770	83	.0002

* No counties had a population center within these distance zones; hence no data are recorded. This means that subsequent regression analyses are based on 12 observations, not 15.

** There are some counties in a particular zone from which no visitation was recorded. The population of these counties must also be included in the total zone population.

\# Primary destination campers only.

These five functions describe possible relationships among visitation, distance, and population. Our goal is to find the relationship that best predicts visitation. An example of form (a) would be V/C = 0.211 - 0.0015 (D)



where 0.211 is the Y-intercept and -0.0015 is the slope of the line that best describes the relationship between visitation and distance. The negative sign attached to the slope indicates that as distance from the project increases, visitation decreases.

Thus, visitation from city X located 100 miles from the project described by the above relationship would be determined as follows:

$$\begin{aligned} \text{visits per capita} &= 0.211 - 0.0015\ (100) \\ &= 0.211 - 0.15 \\ &= 0.061 \text{ visits per capita from city X} \end{aligned}$$

If we knew that the population of city X were 100,000, we would expect 6100 (100,000 x 0.061) visits from that city during a given year.

Deriving the use equation should not be something taken lightly. The use equation is a necessary first step in determining project benefits, the goal of the travel cost method. Therefore, failure to give full attention to collecting the best available data at the initial stage will increase the chances of your benefit estimates being erroneous.

In using form (a) to derive per capita use curves, Pankey and Johnston (1969) noted the problem of heteroscedasticity (a biased estimator) in the regression estimate. To avoid this problem, researchers (Brown and Hansen, Vol. III, 1974; Bowes and Loomis, 1980) recommend the use of forms (b), (c), (d), or (e). We refer interested readers to these two sources for a more detailed discussion of this issue.

Table G-6 contains all the data necessary to compute the five use equations. For example, to compute form (a), we use visits per capita as the dependent variable and distance as the independent variable. As values for distance, we used the midpoints of each zone. For example, the value of distance for the 41-50 mile zone is 45 miles.

Table G-7 displays the results of the regression analysis for each of the 5 functional forms. You may derive these equations by using either a computer or a calculator. We prefer the computer since it is faster and the chances of errors in entering the raw data can be minimized. In addition, the computer provides the opportunity for storing the raw data. Thus, at a later date you may modify the data easily without running the risk of more errors in making the changes by hand. If you decide to derive a use model with more than one independent variable, computer analysis is mandatory.

As indicated in Table G-7, form (c), $V=f\ (P/D^2)$, gives us the largest R^2, 0.86. This means that 86 percent of the observed variation in visitation to Q Lake can be explained by the variable, P/D^2. Since this model gives us the best prediction of visitation and is conceptually plausible, we will use it in subsequent analyses.

Table G-7:
Per Capita Use Equations for Q Lake*

Functional Form	Equation	R^2
a	$V/C = .00556364 - .00004413\ (D)$ (.0015) (.0082)	.52
b	$V = 0.36417114 + .07826997\ (P/D)$ (.8834) (.0505)	.53
c	$V = 5.44525384 + 5.46150513\ (P/D^2)$ (.8279) (.0001)	.86
d	$V = 68.64748813 + 125.11378765\ (P/D^3)$ (.0355) (.0004)	.73
e	$V/C\sqrt{P} = .68498591 - .00000709\ (D\sqrt{P})$ (.0231) (.2403)	.13

* Numbers in parentheses are significance levels of t values. All models are based on 12 observations.

You do not have to collapse data by county into distance zones in order to derive the use model. You could enter the values for visitation, distance, and population by county and then derive your regression estimates. In doing so, you may find better predictive models than those generated by lumping the data into zones. We tried both types of data for Q Lake, but discovered that the data summed by zone gave us our "best" model.

Now that we have a use equation, the next step, estimating use for the MR, is straightforward:

a. determine the market area boundary

b. divide the market area into distance zones

c. estimate the population of these zones

d. determine the value of P/D2 for each zone

e. insert this value into the equation to derive an estimate of visits from each zone

f. sum over all zones.

Remember, these steps are appropriate for this example; depending on what functional form gives you your best model, its requirements would be substituted in steps (d) and (e).

Table G-8 displays these calculations for the MR. We expect 43,541 primary destination camping visits from within the market area to the MR.

Table G-8:
Derivation of Expected Primary Destination Campground Use to the MR from the Market Area as Based on the Prediction Model Selected for the MR

Zone	Population	P/D2	Visits
0-10	98,760	3950.40	21,581
11-20	301,427	1339.68	7,322
21-30	411,201	657.92	3,599
31-40	No counties in this zone		---
41-50	238,264	1117.66	648
51-60	1,037,434	342.95	1,878
61-70	988,884	234.06	1,284
71-80	2,318,666	412,21	2,257
81-90	1,580,371	218.74	1,200
91-100	1,894,683	209.94	1,147
101-110	1,036,602	94.02	519
111-120	1,242,765	93.97	519
121-130	1,656,636	106.02	584
131-140	1,407,334	77.22	427
141-150	2,195,954	104.44	576
		Total	43,541*

* Expected visitation by campers from within 150 road miles, who are using the project as a primary destination.

Camping Benefit Estimation

Using the same reasoning as before for the day use example, the first point on the second stage demand curve is 0 additional miles from the site and 43,541 total visits. To determine the second point, we hypothetically increase the distance between campers' origins and the MR by 10 miles and observe the effect that this increase has on visitation. The origin for a given zone or its distance from the MR, is reckoned as the midpoint of that zone. For example, the first zone's origin or current distance from the MR is 5 miles; adding 10 miles to that origin's current distance of 5 miles gives it a new hypothetical distance of 15 miles. Next calculate P/D2 by dividing origin one's (the first zone) current population, 98,760, by the hypothetical distance squared (152 = 225). Thus, 98,760 divided by 225 = 438.93. Inserting this value into our equation yields a new estimate of visitation, 5.445 + 5.46(438.93) = 2,402. Continue adding increments of 10 miles and estimating number of visits for each origin. Perform these steps until the sum of the original distance of the first zone or zone nearest to the project (in this case 5 miles) plus the added mileage exceeds the market area (150 miles in this example). Repeat this process for all origins (15 here) and sum visits across origins for each distance increment. Continue this process until participation at the MR is zero. This procedure produces a resource or second stage demand schedule showing the number of visits to MR at increasing distances:

Added Miles	Total Visits
0	43,541
10	15,041
20	9,577
30	6,767
40	5,042
50	3,859
60	2,771
70	1,970
80	1,144
90	742
100	400
110	286
120	248
130	119
140	31
150	0

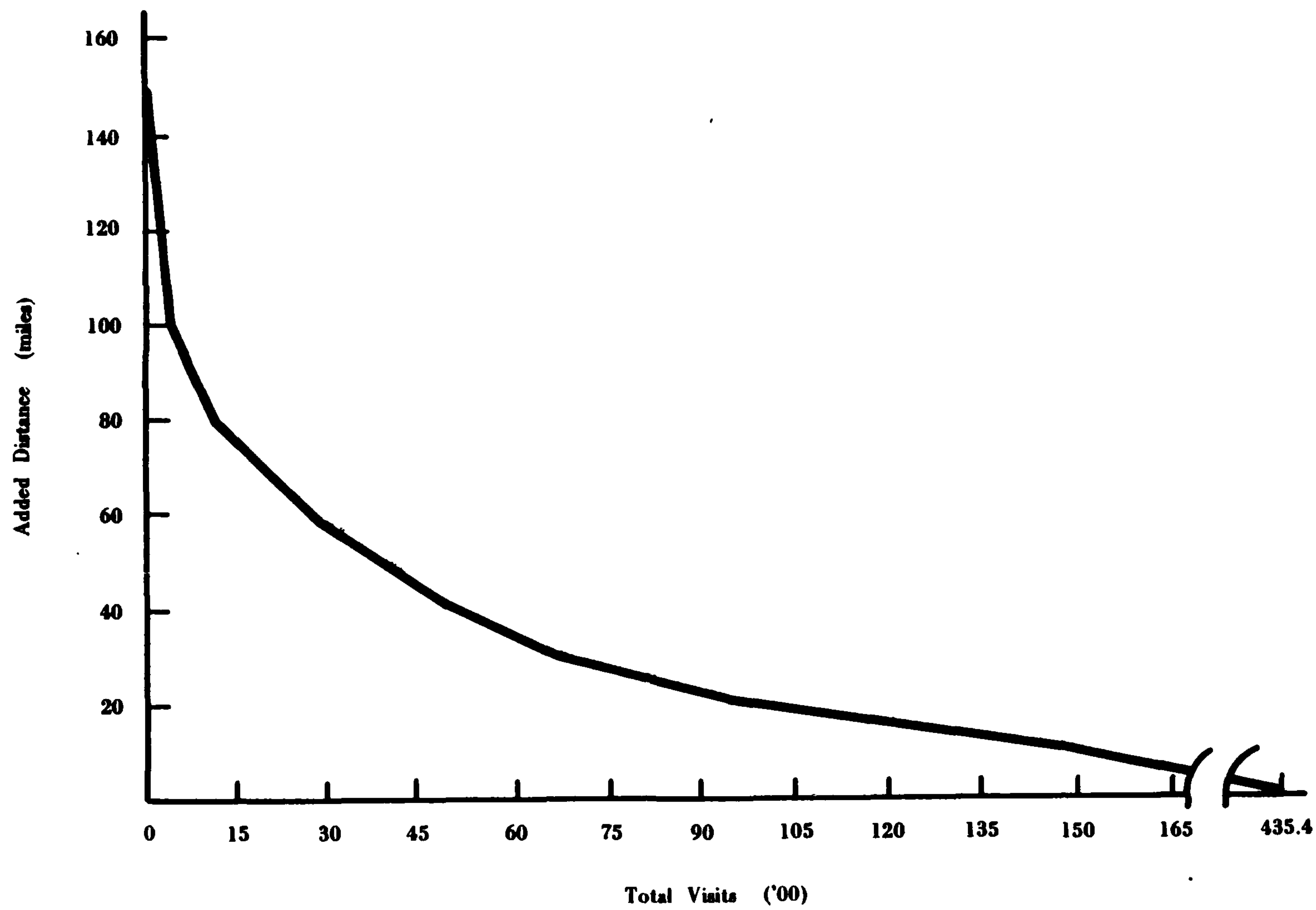
These points are used to plot the second stage demand curve (Figure G-4). Total project benefits are the area under this curve plus the entrance or user fees collected at Q Lake.

To estimate benefits under the curve, we must convert the added mileage into dollars (added travel costs). As was true for the day use example, incurred travel costs included variable motor vehicles costs and the value of travel time. The average cost per mile to the MR is 14.1 cents (See Table G-4). Campground receipt information indicates an average of 3.2 people per vehicle. Thus, the cost per mile per person is 4.4 cents.

To compute the value of travel time per person, we will use nearly the same figures as we did for day use. The only deviation is that for camping we will use 1.2 children per vehicle. Thus, 62.5 percent (2 divided by 3.2) of

Figure G-4

Second Stage Camping Demand Curve for the MR



the campers are adults and 37.5 percent (1.2 divided by 3.2) are children. The value of travel per person per hour is:

$$.625 (\$2.38) + .375 (\$0.60) = \underline{\$1.71}$$

The average vehicle speed is 45 miles per hour. Therefore, the time cost to travel a 10-mile increment is $0.76 ((20 miles round trip divided by 45 miles/hour) x $1.71/hour). The vehicle cost per person for the 10-mile increment is $0.88 (20 miles round trip x $0.044/mile). The total cost for a 10-mile increment is $1.64 ($0.76 + $0.88). The total costs for all the mileage increments are:

Increments (miles)	Round-trip mileage	Time Cost of Travel ($)	Vehicles cost/ Person ($)	Total Cost ($)
10	20	0.76	0.88	1.64
20	40	1.53	1.76	3.29
30	60	2.29	2.64	4.93
40	80	3.06	3.52	6.58
50	100	3.82	4.40	8.22
60	120	4.59	5.28	9.87
70	140	5.35	6.16	11.51
80	160	6.12	7.04	13.16
90	180	6.88	7.92	14.80
100	200	7.64	8.80	16.44
110	220	8.41	9.68	18.09
120	240	9.17	10.56	19.73
130	260	9.94	11.44	21.38
140	280	10.70	12.32	23.02
150	300	11.47	13.20	24.67

We now plot total cost per visit on the Y-axis and total visits on the X-axis to obtain the second stage demand curve converted into dollars. To compute the consumer surplus (total benefits minus fees), we break the area under the curve into trapezoids, determine the area of each, and sum all areas. Carrying out this procedure (the area of each trapezoid is shown in Figure G-5), we derive an estimate of $114,419.

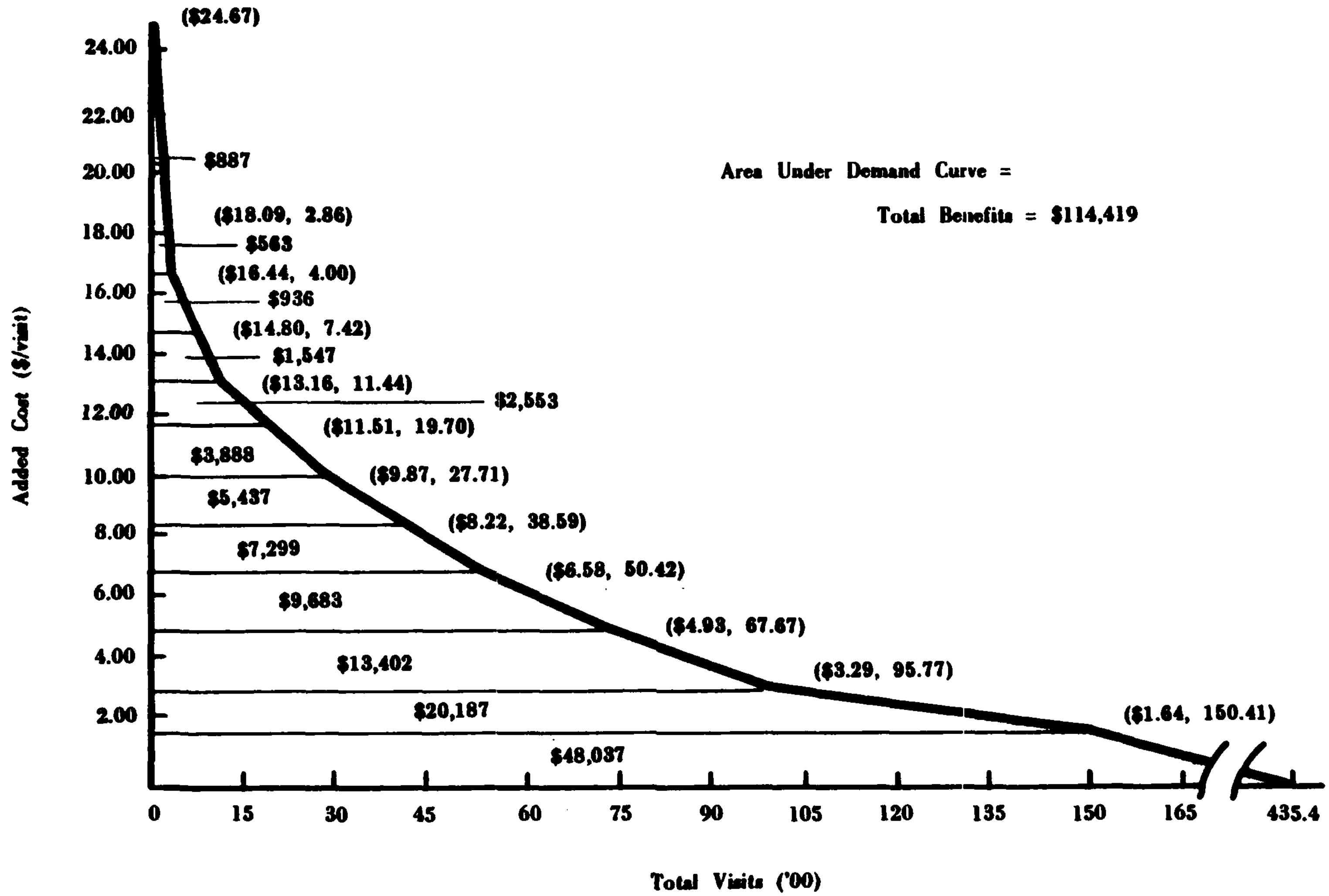
To determine total benefits, we must add expected user fees to the consumer surplus of $114,419. Expected visitation to the MR's fee area from our use estimator is 43,541 visits (Table G-8). This estimate is the expected visitation by campers from within 150 road miles using the project as a primary destination. To estimate total benefits, we must also include expected user fees paid by those campers within 150 road miles using the project as a stopover on a longer trip and all campers from beyond 150 miles. To make this inclusion, we first convert visits into recreation days of use:

43,541 x 1.4 days (average length of stay) = 60,957 recreation days

Next we expand 60,957 recreation days by the proportion of non-primary destination campers within the market area and by the proportion of <u>all</u> campers coming from outside the market area:

Figure G-5

Camping Benefit Estimation for the MR



a. 60,957 divided by 0.985 (proportion of primary destination campers within 150 miles) = 61,885 recreation days of use within the market area

b. 61,885 divided by 0.936 (proportion of all campers within 150 miles) equals 66,116 total recreation days of use from within and outside the market area.

Dividing 66,116 recreation days by 3.2 average persons per party gives us 20,661, the expected number of nights paid for camping. 4.9 percent of the total number of fee receipts collected at Q Lake in 1981 were issued to campers with Golden Age Passports. Thus, we estimate that 1,012 nights of camping (20,661 x .049) at the MR will be by Golden Age Passport holders, while 19,649 (20,661 minus 1,012) will cost the normal fee. If we assume an overnight fee of $4 at the MR, then (19,649 x $4) + (1,012 x $2) = $80,620.

Adding consumer surplus to total revenues yields a total benefit estimate for camping of $195,039 ($114,419 + $80,620).

Adding total day use benefits (Figure G-2) to total camping benefits yields a total recreational benefit estimate of $7,412,397 ($195,039 + $7,217,358).

Summary

Figure G-6 summarizes the steps in the travel cost method. Readers should use Figure G-6 as a quick overview of the travel cost procedure, referring to appropriate sections of the text for more detailed discussions and examples pertaining to each step.

We used both day use and camping data to illustrate the mechanics of the travel cost approach to benefit estimation. The procedures for estimating day use visitation were somewhat different from those used to estimate campground visitation. Under the circumstances we described, both procedures were valid.

In order to increase the reader's understanding of the travel cost approach, we used real data but simplified the procedures. We wish to point out, however, that other factors besides population and distance can be incorporated into use estimation models and thus be given appropriate consideration in benefit calculations. Some of these other factors include site quality, substitutes, socioeconomic characteristics, and management considerations (e.g., carrying capacity). Cited references provide illustrations of more complex applications of the travel cost methodology.

Figure G-6:
Travel Cost Method: Outline

A. Use Estimation

1. Find use estimation model from similar project(s). (If not available, find data from similar project(s) to develop such a model).

2. Determine similar project's market area and decide on appropriate distance zones.

3. Determine population of each distance zone (or county set, county, census tract).

4. Determine amount of visitation from each zone (or county set, county, census tract).

5. Determine use for the alternative in either the following manners:

   a. Determine market area and appropriate distance zones.
   b. Estimate population by distance zone.
   c. Determine amount of visitation from each zone.

   --OR--

   a. Derive regression model showing relationship between the dependent variable (number of visits, visits per capita, etc.) and one or more independent variables (distance, substitutes, etc.)

   b. Substitute into regression equation estimated values of the independent variable for the alternative.

   c. Determine amount of visitation for each zone.

6. Sum over all zones (this figure is total visitation at zero additional cost, the first point of the second stage demand curve).

B. Benefit Estimation

1. Plot added distance on Y-axis and total visitation at various distance on X-axis (first point is zero additional distance and total visitation from A.6. above.

2. Derive subsequent points by increasing distance and observing effect on visitation.

3. Continue deriving points until added distance results in zero visitation (last point on curve).

4. Estimate dollar benefits.

Figure G-6 (continued):
Travel Cost Method: Outline

a. Convert added distance, Y-axis, into dollars (variable motor vehicle costs plus value of travel time). The area under this curve represents the additional willingness of visitors to pay for the experience.

b. Total benefits equals the area under the second stage demand curve (consumer surplus) plus any entrance/user fees.

c. Total benefits divided by total number of visits at zero additional miles (first point) = average benefits per visit.

APPENDIX H: VALUATING USE WITH UNIT DAY METHOD

APPENDIX H: VALUATING USE WITH UNIT DAY METHOD

Unit Day Value

Unit day values represent an attempt to approximate the average willingness to pay of recreationists for a day of recreation activity. When using this method to estimate recreation benefits, departure from an approved range of values is not permissible. If preliminary evaluations indicate a value outside of the range, either a travel cost or a contingent value study is generally indicated. Due to the nature of the unit day value method, the burden is on the planner to justify its use and to explain the selection of any particular value whether it is for a general or specialized recreation activity.

Information Needed

Prior to implementation of the technique, the planner will need to conduct the following tasks:

- Identify and analyze the recreation market.
- Determine the recreation need for both existing and future conditions by type of recreation activity.
- Calculate resource capability.
- Investigate recreation opportunities foregone.
- Characterize both the with and without resource conditions in terms of annualized recreation days by activity.

Description of Procedure

The mechanics of the technique are fairly simple and can be reduced to the framework diagrammatically displayed below:

Annual Value Recreation Use = Estimated Average Annual Use x Value of a Day of Recreation

Estimated Average Annual Use — Obtained Via:

Use Estimating Equation
(Use Estimating Model)
OR
Per Capita Use Curve
(Similar Project Approach)
OR
Use Capacity
(Capacity Method)

Value of a Day of Recreation — Obtained Via:

Comparable
Market Prices
OR
Point System

The steps in the procedure are stated as follows, further details on the selection of value for a day of recreation (Step 2) are given in the sections immediately after the list.

Step 1. For each recreation activity or category of activity, under both with and without conditions, obtain the value of a day of recreation.

Step 2. In the context of with project conditions, and for each recreation activity or category of activity, multiply the value of a day of recreation by the estimated average annual use.

Step 3. Sum the values obtained in Step 2 to derive total activity benefit.

Step 4. Divide by the total estimated average annual recreation activity days to compute an average unit value per recreation day.

Step 5. Multiply the value obtained in Step 4 by the estimated annual use over the project life.

Step 6. Repeat Steps 2-5 for without project conditions for those activities expected to be diminished by the project.

Step 7. Compute net benefit as the difference between values obtained in Steps 6 and 7.

Clearly, the most significant step in the application of the unit day value method is Step 1, in which the value of a day of recreation is assigned. As just indicated in the diagrammatic framework for the method, the value of a day of recreation can be obtained in either of two ways: via use of comparable market prices or via the point system. The process for assignment of values through both of these ways is described in the following sections.

Use of Comparable Market Prices to Obtain Value. In this alternative, the planner selects a value from within the ranges of unit day values for both generalized and special recreation activities. These ranges are updated and published each year by the Water Resources Council. Local market price information provides guidance in the selection of a value from within the range. In general, three conditions must be met:

1. The amount of recreation opportunities provided at the site must not significantly change the total amount of similar recreation available in the affected area; 20 percent of the total is the maximum change permitted.

2. Recreation opportunities to be created or destroyed by a proposed project must be similar in all important respects (e.g., distance from user populations, facilities, quality) to the recreation opportunities for which market data are obtained.

3. Market prices must reflect only use of the site and associated facilities (i.e., they must be equivalent to entrance or use fees).

Guidance is obtained from local prices by a sample of market values drawn from at least ten private sector establishments with comparable facilities in the affected recreation area. Prices or entry fees at public sites may not be included. The price data should be annualized to remove seasonal variability if needed. The average of the prices is then used as the activity day value if it falls within the appropriate range of published values. If the average does not fall within the range, it may be used only if fully documented and justified.

Each of the activity day values is then weighted by the predicted annual use for each activity. The sum of total activity values divided by the sum of annual activity use days yields a weighted value for the average recreation day. This value should be comparable to that obtained by the alternative approach, the point system. A final check of the reasonableness of the selected unit value is whether or not it represents the amount prospective recreationists should be willing to pay to enjoy the recreational opportunities to be afforded by the project.

Use of the Point System to Obtain Value. In this alternative, the planner uses tables that categorize certain attributes of recreation activities. Based on these categories, points are assigned. Then, using another table, the point score is translated into a dollar value per recreation day. In the Principles and Guidelines, the WRC provides guideline tables for use in the point system. They are merely suggested tables, others may be used. The table that converts points to dollars is set up using the same range of values as are updated and published each year by the Water Resources Council. Two tables are available for assigning points and are differentiated as follows:

a. For general recreation such as picnicking, camping, hiking, riding, cycling, fishing, and hunting.

b. For specialized recreation such as big game hunting, wilderness pack trips, white water canoeing, and other relatively unique experiences.

To use the tables, the planner judges each activity against each of the specified attributes assigning an appropriate point value. For each activity the points are summed across attributes, and the total is used to derive an activity unit day value from the conversion table. As with the market price approach, each of the activity day values is weighted by that activity's predicted annual use. The sum of total weighted activity values divided by the sum of total annual activity days yields a weighted value for use with estimates of recreation days.

By setting up and categorizing attributes, the point system provides a means of explicitly taking into account some of the factors that influence recreation demand and narrows the vagaries of professional judgement as required for the comparable market price method. The validity of the system rests on the subjective judgements of the person who developed the tables as well as the analysts who use them.

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